U.S. Department of Transportation
Federal Highway Administration

INTRODUCTION

TRANSPORTATION PERFORMANCE MANAGEMENT (TPM) OVERVIEW

Transportation Performance Management (TPM) is a strategic approach that uses system information to make investment and policy decisions to achieve performance goals. An increasing number of transportation agencies are adopting TPM principles to ensure the right bundle of projects is selected and delivered to produce the performance outcomes desired by the agency, external partners, elected officials, and the public. TPM helps determine what results are to be pursued, using information from past performance levels and forecasted conditions to guide investments, measuring progress toward strategic goals, and making adjustments to improve performance. TPM is grounded in sound data management, usability, and analysis as well as in effective communication and collaboration with internal and external stakeholders. The key to successful implementation of TPM practices lies in the organizational support and agency embrace of data-driven decision making.

WHY IS TPM IMPORTANT?

TPM uses performance information to create a linkage between an agency's strategic direction, resource allocation decisions, individual employee activities, and external stakeholders' priorities. Some benefits of instituting TPM practices include:

- **Creation of Unifying Focus for Agency**: Carefully considered and connected goals, objectives and measures become the structure upon which an agency's transportation performance management approach rests. Clearly communicating "where do we want to go" builds staff support for the agency's purpose and provides a unifying direction for day-to-day activities. Additionally, articulating longer term outcomes for an agency and determining how progress will be evaluated not only helps clarify what the public and other stakeholders expect from the agency, but also links transportation investments to what the public cares about.
- **Prioritization of Investments Based on Performance Needs**: Information on past performance and expected future conditions enables agencies to guide resources to areas most in need of attention, thus using resources most effectively. Data highlight areas of lagging performance, enabling prioritization of projects to address such lags. By making decisions to improve how the transportation system functions, agencies engaged in TPM can minimize life-cycle costs of assets.
- **Feedback Loop between Decisions and Results**: The active use of performance information provides key insights into the effectiveness of strategies and can identify where project and/or program adjustments need to be made. Data on results can also provide new insights into causal factors contributing to performance outcomes and identify data gaps that need to be closed.

> "The Bay Area Long Range Transportation Plan has shifted away from traditional goals like 'system preservation' and now fully reflects how transportation agencies can help the region's citizens fulfill their priorities like 'healthy and safe communities.'"
>
> - Dave Vautin, MTC

- **Connect Individual Staff Activity to Agency Goals**: A transportation performance management approach creates the opportunity to demonstrate to each individual staff member how their work contributes to the attainment of agency goals, objectives and performance targets. Strategic goals and targets are "why" employees perform their assigned tasks.
- **Transparent Decision-Making**: TPM demonstrates to external stakeholders that the agency is taking an analytical, data-driven approach to decision making. As public entities, transportation agencies must prove that they are using public money prudently by being transparent about how decisions are made.

> "All employees need to understand how what they do affects the traveling public. It's not just filling a pothole, it's creating a safer environment, a better quality and more reliable drive for the traveling public."
>
> - Stacey Strittmatter, Texas DOT

- **Linking Funding Requests to System Performance**: Performance data can indicate the effect of declining or increasing funding levels on performance of the transportation system; by making the case to policymakers using data, agencies can and have been successful in obtaining increased funding.
- **Communication of the Benefits from Transportation Investments**: Through engagement with the public and other stakeholders, agencies clearly understand what performance outcomes are desired. Performance data enables agencies to inform external stakeholders on the results of investment decisions.
- **Fulfillment of Legislative Requirements**: The Moving Ahead for Progress in the 21st Century (MAP-21) Act[1] and the subsequent Fixing America's Surface Transportation (FAST) Act[2] put greater emphasis on TPM by requiring use of such practices in statewide, metropolitan, and non-metropolitan transportation planning. Although this guidebook does not serve as official guidance on the implementation of federal legislation, employing TPM practices will assist with implementing TPM-related regulatory requirements.

> "Why do we look at performance information? It is pretty simple. We are investing money in our transportation system and want to know what we get for it."
>
> - Camelia Ravanbakht, Hampton Roads Transportation Planning Organization

Above all else, TPM leads to improved performance. The condition of bridges, pavement, transit vehicles, and bike infrastructure will improve within a TPM practice, leading to improved conditions for system users in areas such as safety, mobility, and public and environmental health. Using data, agencies can allocate resources to address regional priorities and ensure that every dollar is spent to impact performance in a positive way.[3]

[1] Moving Ahead for Progress in the 21st Century. May 23, 2016. http://www.fhwa.dot.gov/map21/
[2] Fixing America's Surface Transportation Act. May 23, 2016. http://www.fhwa.dot.gov/fastact/
[3] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

TPM FRAMEWORK

The Transportation Performance Management Framework, shown in Figure Intro-2, builds upon over a decade of TPM research (as noted in Appendix B) and agency practices. Much of the Framework is familiar, though some changes have been made to expand upon the framework for performance-based planning and programming (Figure Intro-1) presented in FHWA's *Performance-Based Planning and Programming Guidebook*.[4]

> "A performance-based approach shifts the focus off of 'can we deliver the project on budget' to 'are we doing the right set of projects.' Monitoring and adjustment processes help us understand project results – information that is key to picking an effective set of projects year after year to maximize taxpayer investment into the system by focusing on projects that truly drive a better and safer outcome."
>
> - Greg Slater, MD State Highway Administration

Monitoring and Adjustment (Component 05) emphasizes that what agencies **do** with performance information distinguishes transportation performance **management** from performance **measurement**. Under a traditional transportation performance measurement framework, an agency sets a strategic direction, defines measures, and tracks results without a strong feedback loop that adjusts programming mid-stream. The evolution of transportation performance management urges agencies to actively use information gained from monitoring performance data to obtain key insights into the effectiveness of decisions and identify where adjustments in programming need to be made. The combination of monitoring and adjustment processes is the "bread and butter" of advanced TPM practices, establishing a critical feedback loop between performance results and future planning, programming and target setting decisions.

Figure Intro-1 Framework for Performance-Based Planning and Programming

Source: Performance-Based Planning and Programming Guidebook.[5]

[4] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

[5] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

The TPM Framework also emphasizes the importance of Organization and Culture, External Collaboration and Coordination, Data Management, and Data Usability and Analysis. Organization and Culture (Component A) is depicted as a circle surrounding all other components within the Framework because the organization and culture of an agency impacts all other processes that are undertaken. Without a supportive agency culture, TPM processes will be difficult to implement and will likely fail to be sustainable. A focus on building leadership team support, clarifying TPM roles and responsibilities, integrating TPM into management practices and providing workforce training are important to the successful implementation of TPM.

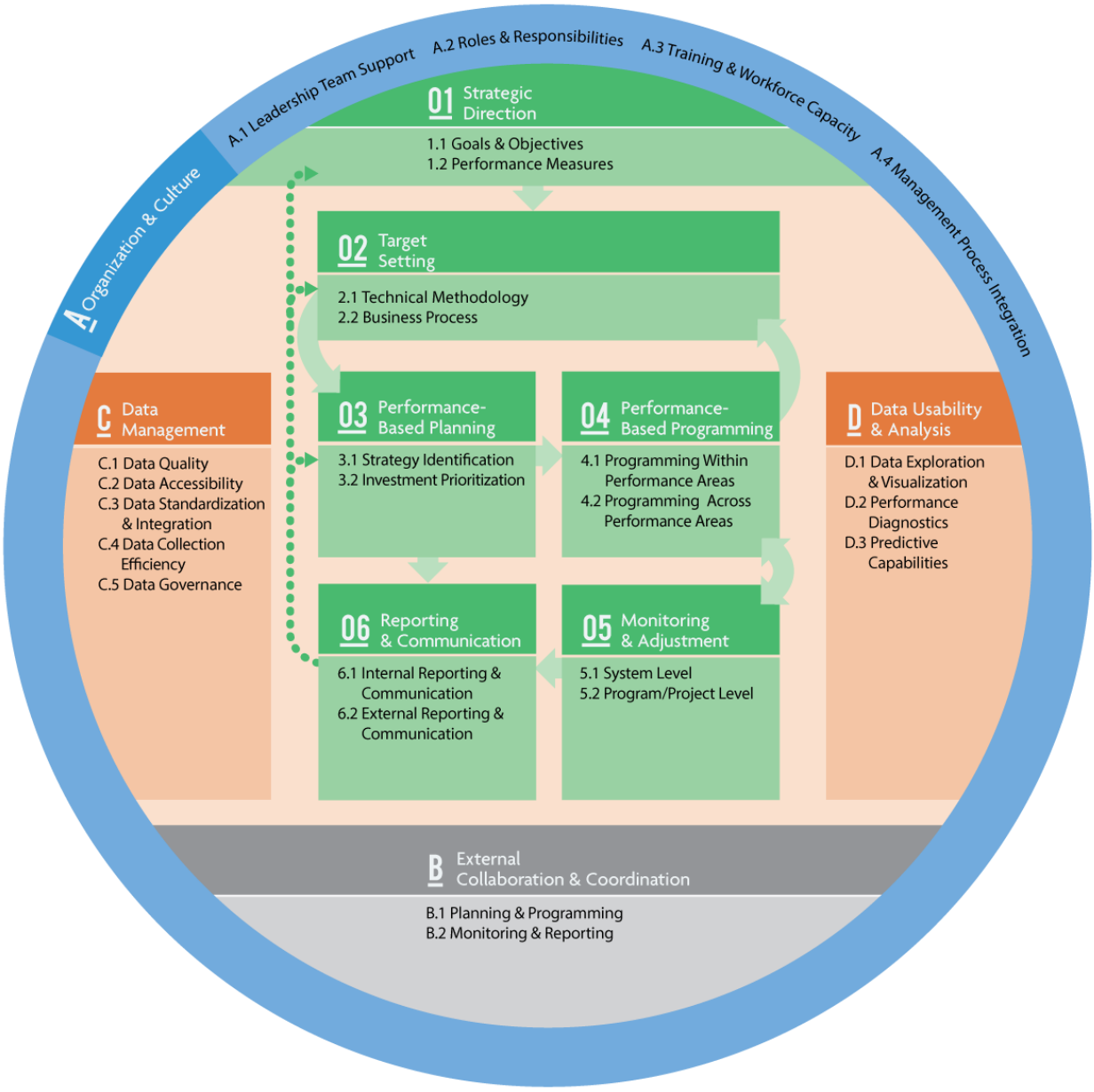
The External Collaboration and Coordination (Component B) element seeks to emphasize how external partnerships and involvement are interwoven throughout TPM practices, including planning, programming, monitoring, and reporting. It is important to note that within each of the components, internal collaboration is stressed as a fundamental element.

Two components concerning data, Data Management (Component C) and Data Usability and Analysis (Component D), emphasize how essential data is to transportation performance management. Data are the foundation of TPM, and these two components will assist agencies in developing their data for use in activities throughout the other components.

While components are numbered from 01-06 and A-D for ease of reference, TPM activities do not necessarily happen in order. The figure illustrates some of the linkages and feedback loops that are inherent in TPM, such as:

- Monitoring and Adjustment (Component 05) may feed back into Performance-Based Programming (Component 04)
- Performance Based Programming (Component 04) may feed back into Target Setting (Component 02)
- Reporting and Communication (Component 06) may feed back into Performance-Based Planning
- (Component 03), Target Setting (Component 02), and Strategic Direction (Component 01)

Figure Intro-2 TPM Framework



Definitions for each component are provided below; subcomponent definitions are contained in guidebook chapters.

Component 01. Strategic Direction

Definition: The establishment of an agency's focus through well-defined goals and objectives, enabling assessment of the agency's progress toward meeting goals and objectives by specifying a set of aligned performance measures. The Strategic Direction is the foundation upon which all transportation performance management rests.

Component 02. Target Setting

Definition: The use of baseline data, information on possible strategies, resource constraints, and forecasting tools to collaboratively establish a quantifiable level of performance the agency wants to achieve within a specific time frame. Targets make the link between investment decisions and performance expectations transparent across all stakeholders.

Component 03. Performance-Based Planning

Definition: The use of agency goals and objectives and performance trends to drive the development of strategies and priorities in the long-range transportation plan and other performance-based plans and processes. The resulting planning documents become the blueprint for how an agency intends to achieve its desired performance outcomes.

Component 04. Performance-Based Programming

Definition: The use of strategies and priorities to guide the allocation of resources to projects that are selected to achieve goals, objectives, and targets. Performance-based programming establishes clear linkages between investments made and expected performance outputs and outcomes.

Component 05. Monitoring and Adjustment

Definition: A set of processes used to track and evaluate actions taken and outcomes achieved, thereby establishing a feedback loop to refine planning, programming, and target setting decisions. It involves using performance data to obtain key insights into the effectiveness of decisions and identifying where adjustments need to be made in order to improve performance.

Component 06. Reporting and Communication

Definition: The products, techniques, and processes used to communicate performance information to different audiences for maximum impact. Reporting is an important element for increasing accountability and transparency to external stakeholders and for explaining internally how transportation performance management is driving a data-driven approach to decision making.

Component A. Performance Management Organization and Culture

Definition: Institutionalization of a transportation performance management culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support transportation performance management.

Component B. External Collaboration and Coordination

Definition: Established processes to collaborate and coordinate with agency partners and stakeholders on planning/visioning, target setting, programming, data sharing, and reporting. External collaboration allows agencies to leverage partner resources and capabilities, as well as increase understanding of how activities impact and are impacted by external factors.

Component C. Data Management

Definition: A set of coordinated activities for maximizing the value of data to an organization. It includes data collection, creation, processing, storage, backup, organization, documentation, protection, integration, dissemination, archiving, and disposal. Well-managed data are essential for a robust TPM practice.

Component D. Data Usability and Analysis

Definition: Existence of useful and valuable data sets and analysis capabilities available in accessible, convenient forms to support transportation performance management. While many agencies have a wealth of data, such data are often disorganized, or cannot be analyzed effectively to produce useful information to support target setting, decision making, monitoring, or other TPM practices.

GUIDEBOOK OVERVIEW

PURPOSE

The focus of this guidebook is to move the theory of TPM into practice by providing "how-to" information for agencies interested in implementing or improving the application of TPM principles. For each TPM Framework component, the guidebook describes the component's key concepts, highlights the interrelationships between the other nine components, defines associated terminology, and presents a customizable action plan worksheet. However, the majority of the guidebook outlines concrete steps agencies can take to establish or enhance their TPM approach. To further the exchange of noteworthy practices and assist agencies with implementation, each step is augmented by examples and practitioner quotes from around the country.

This guidebook is tailored to transportation agencies interested in implementing or enhancing TPM practices, including State DOTs, MPOs, and transit agencies. As much as possible, jargon and overly technical terms are avoided to make the guidebook more accessible to staff at all levels and in all divisions within an agency. For the sake of brevity, not all background information and TPM research is included. Instead, a select list of resources that provide additional details on TPM (e.g., FHWA's *Performance-Based Planning and Programming Guidebook*[6]) is included in each chapter.

The Guidebook is not intended to establish requirements or standardize practices that must be used by all agencies and does not serve as official guidance on implementation of federal legislation. However, given the role MAP-21 Act and the subsequent FAST Act[7] are having in the establishment of TPM as a sound business practice, each guidebook chapter includes links to legislative and regulatory resources.

> "The guidebook is written with words that normal humans can understand."
>
> - Member, TPM Stakeholder Group

Finally, the guidebook emphasizes that the implementation of TPM practices will not be a one-off activity. Implementation will be step-wise and gradual, with continuous improvement over time.

HOW TO USE THE GUIDE

It is recommended that all Guidebook users first review the two-page fact sheets for each of the ten TPM components and for the overall guidebook. These condensed versions of the guidebook chapters provide a comprehensive view of TPM principles and may be useful as staff attempt to build support or educate their peers about particular aspects of TPM. These fact sheets will also help identify which TPM component guidebook users would like to further explore.

[6] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

[7] Legislation, Regulations, and Guidance. May 23, 2016. http://www.fhwa.dot.gov/resources/legsregs/

Overall, the guidebook is designed to be modular as much as practicable to enable users to zero in on a particular aspect of transportation performance management. The guidebook is not intended to be read from front to back. Instead, it provides actionable information that can be easily identified and implemented by agencies. Although each Guidebook chapter is a stand-alone resource, the linkage between the various TPM components and subcomponents are continually highlighted. TPM, by its very nature, is an integrated process, as demonstrated in Figure Intro-1.

> "The real world examples and practitioner quotes provide a reality check to the guidebook. This isn't just another academic publication, but a resource that provides feasible ideas for agencies to implement to improve their processes."
>
> - Karen Miller, Missouri DOT

Given the focus on providing a "how-to" guide, the majority of each chapter is dedicated to describing recommended implementation steps for each of the 26 TPM subcomponents. A description of each implementation step is followed by one or more examples and quotes from agencies that have undertaken certain aspects of the step. These provide real-world illustrations of the theoretical information provided in the description, and enable staff to reach out to the agency highlighted for further information or assistance in their own implementation activities.

The guidebook belongs to a series of TPM resources available through the TPM Toolbox (www.tpmtools.org). Designed to work together, all TPM Toolbox resources are interconnected. There are five main resources available:

- **TPM Framework:** Graphical representation of the ten TPM components and their subcomponents, as well as the relationships between components.
- **TPM Capability Maturity Self-Assessment:** Interactive method to determine an agency's level of maturity and action items to improve TPM practices (using the capability maturity model described below).
- **Practitioner Consortium:** Searchable database of agency staff nationwide who may serve as a resource for other agencies or as subject matter experts at TPM events.
- **Guidebook:** How-to guide for implementing TPM practices, as described here.
- **Resources:** Library of relevant TPM resources that will further assist those interested in expanding and/or improving TPM practices at an agency.

Guidebook users are encouraged to utilize these resources and visit the TPM Toolbox website often to access additional information.

TPM Capability Maturity Model

In 1991, the Carnegie Mellon Software Engineering Institute (SEI) published a capability maturity model (CMM) to provide the federal government with a method for assessing the capability of its software contractors. The CMM for software proved to be very successful and achieved a high level of adoption. The maturity model concept has been adapted for a wide variety of process and domain areas. Maturity models have proved to be a useful framework that can be applied in order to assess an organization's current state, identify a logical set of improvements, and show the benefit of moving to higher capability levels.

Based upon extensive review of transportation and non-transportation related capability maturity models and the existing resources on TPM practices, the TPM Capability Maturity Model was created. The primary objective of the TPM CMM is to provide maturity level descriptions for the TPM components that transportation agencies could begin using to evaluate their TPM capabilities, and identify areas where the agencies should take steps to improve these capabilities. The TPM CMM maturity level descriptions for each component are available on the TPM Toolbox website and reflect the general descriptions contained in Table Intro-1.

Table Intro-1 General TPM Capability Maturity Levels

Maturity Level	Description
1-Initial	Transportation performance management processes are generally champion-driven, ad-hoc, uncoordinated, and reactive in nature. Success may result from heroic activities on the part of champions rather than from established agency processes and culture. Performance measures may exist to meet reporting requirements but are primarily driven by what data are available rather than by providing meaningful and actionable indicators of progress. There is little alignment across different performance-based plans, and between planning and programming. Collaboration is reactive rather than proactive.
2-Developing	Work is underway to strengthen transportation performance management in the agency. A transportation performance management framework is being defined to provide alignment across the organization and across different planning and programming functions. Modifications to data collection and management processes and analysis tools are being planned in order to better support the performance framework. Organizational roles are being defined, and a strategy for training and workforce development in support of transportation performance management is being developed.
3-Defined	The agency has a well-defined and documented framework of goals, objectives, and performance measures. Roles and responsibilities for transportation performance management have been defined, but not yet fully implemented. Data are available to support measure calculation. An approach to target setting has been defined based on use of baseline and trend data. Analysis tools and data reporting systems are in place, but have not yet gone through a "shakeout" period to ensure that they fully meet the needs.
4-Functioning	Transportation performance management practices have been institutionalized. Staff at multiple levels of the organization understand their roles with respect to achievement of performance targets and are held accountable. Performance reporting processes are well-established and available systems are functioning as intended. Information provided is used to inform actions and pursue course corrections. There is alignment across planning partners on performance measures, benchmarks, and targets. Performance data may still have gaps and quality issues, but processes are in place to improve these over time. Basic predictive capabilities are in place for future performance projections and are starting to be applied. Resource allocation processes are data-driven within performance areas. The agency is able to analyze tradeoffs across selected performance areas, though resource allocation may not be based on these tradeoffs. Data are being gathered to evaluate the costs and effectiveness of actions taken. Communication of performance results is being pursued in a deliberate and strategic manner, with different levels and formats of information designed to meet the needs of different internal and external audiences.
5-Sustained	Transportation performance management is ingrained in the agency culture to a point where it would be expected to be sustained across changes in leadership. Managers at multiple levels of the agency depend on performance data for planning, budgeting, needs assessment, and prioritization activities. A solid base of evaluation information is available to allow for project/action selection and prioritization based on an understanding of cost-effectiveness. Performance data are generally considered to be credible and reliable. Data quality and availability are regularly assessed and improved. Performance results made available to external agency stakeholders are positively received and are strengthening agency credibility, helping to make the case for required resources.

TPM Maturity Assessment

The TPM Capability Maturity Self-Assessment provides an evaluation of an agency's TPM practices as a whole and for each TPM component based on a 1-5 scale similar to Table Intro-1. In addition, the assessment refers to sections of the guidebook which will be useful for moving the agency to the next maturity level. Because State DOTs may have more advanced performance capabilities in selected areas (e.g., safety or pavement management), the assessment tool allows for assessments to be conducted for individual performance areas.

ACKNOWLEDGEMENT

This document was developed in collaboration with stakeholders across the transportation industry. It was guided by the TPM Stakeholder Group, which spent hours assisting in development of the capability maturity model (CMM) and reviewing draft deliverables. Members of the Group were selected based on previous work in transportation performance management, previous activities with FHWA (conferences, peer exchanges, webinars), and consultation with national industry associations. The Committee included MPO, State DOT and transit agency staff members, with consideration given to geographic balance. Members of the TPM Stakeholder Group included:

- Ben Reeser, Missouri Department of Transportation
- Brian Hoeft, Regional Transportation Commission of Southern Nevada
- Brian Reagan, Missouri Department of Transportation
- Camelia Ravanbakht, Hampton Roads Transportation Planning Organization
- Christina O'Claire, King County Metro Transit
- Christos Xenophontos, Rhode Island Department of Transportation
- Coco Briseno, California Department of Transportation
- Craig Lyon, Anchorage Metropolitan Area Transportation Solutions
- Dan Davis, Washington State Department of Transportation
- Daniela Bremmer, Washington State Department of Transportation
- Dave Lee, Florida Department of Transportation
- Dave Springstead, Metropolitan Atlanta Rapid Transit Authority
- Dave Vautin, Metropolitan Transportation Commission
- David Kuhn, New Jersey Department of Transportation
- Dick Jarrold, Kansas City Area Transportation Authority
- Eric Hesse, Tri-County Metropolitan Transportation District of Oregon
- Erik Filkorn, Vermont Agency of Transportation
- G.J. LaBonty, Utah Transit Authority
- Greg Slater, Maryland State Highway Administration
- Jeff Sudmeier, Colorado Department of Transportation
- Jennifer Brandenburg, North Carolina Department of Transportation (former)
- Jessie Jones, Arkansas State Highway and Transportation Department
- Jim Ritzman, Pennsylvania Department of Transportation
- John Milton, Washington State Department of Transportation
- John Orr, Atlanta Regional Council
- Jose Thommana, District Department of Transportation
- Kanti Srikanth, Metropolitan Washington Council of Governments
- Karen Miller, Missouri Department of Transportation
- Kelly Travelbee, Michigan Department of Transportation

- Lori Richter, Wisconsin Department of Transportation
- Lynn Zanto, Montana Department of Transportation
- Lynnette Ciavarella, Metra (Regional Transportation Authority)
- Machelle Watkins, Missouri Department of Transportation
- Mark Gieseke, Minnesota Department of Transportation
- Marsha Fiol, Virginia Department of Transportation
- Matt Sibul, Utah Transit Authority
- Michelle Conkle, Texas Department of Transportation
- Monique de los Rios Urban, Maricopa Association of Governments
- Nancy Cisarik, Metra (Regional Transportation Authority)
- Paul Degges, Tennessee Department of Transportation
- Peter Spaulding, California Department of Transportation
- Richard Brockmyer, Utah Transit Authority
- Rolando Cruz, Long Beach Transit
- Ron Achelpohl, Mid-America Regional Council
- Scott Omer, Arizona Department of Transportation
- Stacey Strittmatter, Texas Department of Transportation
- Tammy Haas, New Mexico Department of Transportation
- Tonia Norman, Texas Department of Transportation

Federal Highway Administration and Federal Transit Administration staff, along with national industry associations, played a key role in this project. Support for the project was provided through identification of printed resources, identification of TPM Stakeholder Group members, and review of draft deliverables, among other tasks. The American Association of State Highway and Transportation Officials (AASHTO), Association of Metropolitan Planning Organizations (AMPO), and the American Public Transportation Association (APTA) all offered support to this project. Specific individuals we would like to thank are:

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- Matt Hardy, AASHTO
- Rich Weaver, APTA

U.S. Department of Transportation
Federal Highway Administration

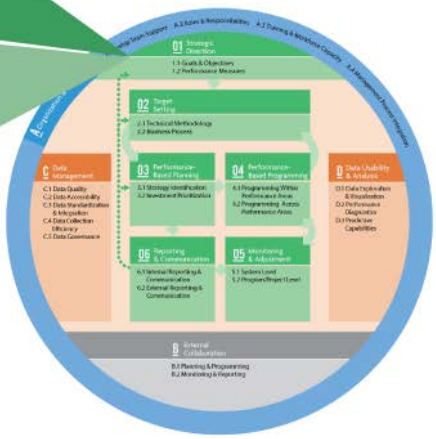
COMPONENT 01

STRATEGIC DIRECTION

This chapter provides assistance to transportation agencies with the "Strategic Direction" component of Transportation Performance Management (TPM). It discusses where the strategic direction occurs within the TPM Framework, describes how it interrelates with the other nine components, presents definitions for associated terminology, provides links to regulatory resources, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for strategic direction may differ from what is included in this chapter.

01 Strategic Direction

1.1 Goals and Objectives
1.2 Performance Measures



The **Strategic Direction** is the establishment of an agency's focus through well-defined goals and objectives, enabling assessment of the agency's progress toward meeting goals and objectives by specifying a set of aligned performance measures. The Strategic Direction is the foundation upon which all transportation performance management rests.

INTRODUCTION

A Strategic Direction is established when an agency develops and institutes goals, objectives, and a set of aligned performance measures to track progress. Defining these elements is a critical first step in the TPM process because together they determine the strategic direction for an agency and the means to assess performance changes. Carefully considered and connected goals, objectives, and measures become the structure upon which an agency's transportation performance management approach rests. This strategic direction should be integrated into an agency's business plan and related documents.

Establishment of a Strategic Direction benefits an agency by:

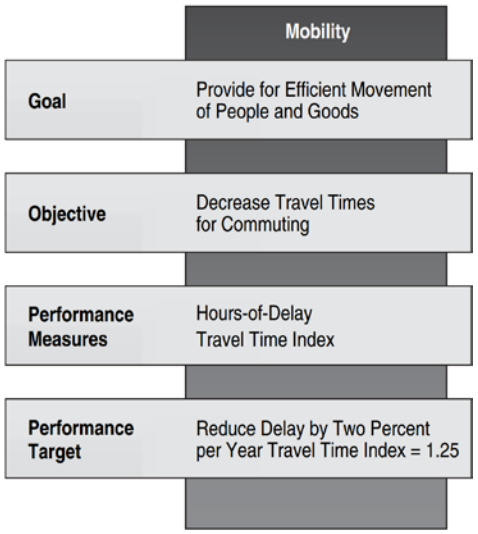
- Bringing about staff support for the agency's purpose;
- Clarifying what the public and other stakeholders expect from the agency;
- Focusing on current and future performance outcomes;
- Setting a clear direction for agency decision-making;
- Outlining how individual employees play a role in achieving agency goals and objectives;
- Guiding day to day activities using a unifying and overarching structure; and
- Identifying possible funding needs.

> "If you don't know where you are going, you will end up somewhere else."
>
> - Laurence Peter, US educator & writer (1919 - 1988)

When establishing a Strategic Direction, first an agency determines "*where do we want to go*," by crafting goals and objectives through a collaborative and inclusive process involving both internal staff and external stakeholders (e.g., policymakers, partners, citizens). The purpose of the resulting goals and objectives is to identify longer term outcomes for an agency. Assessing progress toward achievement of the goals and objectives, performance measures create a direct link between actions taken by an agency and results. For example, the construct displayed in Figure 1-1 communicates to staff that the agency is focused on providing efficient movement of people and goods and that the achievement of this outcome will be determined by a reduction in travel time index.

Figure 1-1: Relationship Between Goals, Objectives, Performance Measures, and Targets.

Source: Strategic Highway Research Program 2[1]



[1] From *SHRP 2 Report S2-C02-RR: Performance Measurement Framework for Highway Capacity Decision Making*, Figure 2.4, p. 19. Copyright, National Academy of Sciences, Washington, D.C., 2009. Reproduced with permission of the Transportation Research Board.

Together goals, objectives, and performance measures set the stage for an agency to answer, "*how are we going to get there.*" To begin answering this question, agencies use baseline data, information on possible strategies, funding constraints and forecasting tools to collaboratively establish performance targets (Component 02). The Strategic Direction combined with established targets describe how an agency will measure its achievement of identified performance outcomes. The agency will use that description of achievement as the foundation from which strategic decision-making occurs, thereby guiding the identification of strategies and investments that can and should be implemented during Performance-Based Planning (Component 03).

> "Agency goals should become the steady drumbeat in the background that inspires action—the goals should be ingrained in the subconscious of workers so that they live the performance management culture."
>
> Source: "Moving from Reactive to Strategic Decision Making." TR News 293 July-August 2014

From there, the Strategic Direction influences how the agency answers "*what will it take,*" using Performance-Based Programming (Component 04) to prioritize and allocate resources within and across performance areas. The Strategic Direction also drives an agency's response to "*how did we do*" by linking the answer to this question back to agency goals and objectives and using performance measures to assess progress. The Monitoring and Adjustment (Component 05) activities agencies conduct expand the understanding about what is influencing performance outcomes and improve the delivery of programs in order to achieve desired results. The goals, objectives and measures in the Strategic Direction also serve as the foundation for communicating performance changes. In short, every stage of the TPM process links back to the Strategic Direction and the pursuit of attaining agency goals and objectives.

For a Strategic Direction to become engrained in the agency culture and embraced by external stakeholders, it should be grounded on four major building blocks:

- **Performance information:** The selected goals, objectives and measures focus an agency's policy and investment decisions and therefore should be based on performance condition information across a range of performance areas. On what key area(s) does current performance data and future projections suggest that an agency should focus? An agency's ability to answer such questions is dependent on its ability to use, analyze, and manage its data. See Data Management (Component C) and Data Usability and Analysis (Component D).
- **Internal buy-in:** To create a performance atmosphere within an agency, individual staff must be able to see their role in attaining goals and objectives by connecting their daily activities to the agency's strategic direction. See Organization and Culture (Component A).
- **External buy-in:** Agency goals, objectives and measures must reflect what the public, customers, policymakers, and other stakeholders care about and align with regional priorities to appear worthwhile to the public. See External Collaboration and Coordination (Component B).
- **Continuous messaging and demonstration of commitment to goals:** In order to cement the Strategic Direction at an agency, goal language should appear in internal and external communications (e.g., signature lines for emails), be visually displayed (e.g., posters), be included in regular business activities (e.g., employee performance plans), and discussed during interactions with external stakeholders. See Reporting and Communication (Component 06) and Organization and Culture (Component A).

SUBCOMPONENTS AND IMPLEMENTATION STEPS

The component Strategic Direction is defined as the establishment of an agency's focus through well-defined goals and objectives, enabling assessment of the agency's progress toward meeting goals and objectives by specifying a set of aligned performance measures. The Strategic Direction is the foundation upon which all transportation performance management rests.

Strategic Direction is broken down into two complementary subcomponents:

- **Goals and Objectives:** Goals are broad statements articulating a desired end state that provide strategic direction for an agency. Objectives are specific, measurable statements that support achievement of a goal.[2]
- **Performance Measures:** Performances measures are based on a metric that is used to track progress toward goals, objectives, and achievement of established targets. They should be manageable, sustainable, and based on collaboration with partners. Measures provide an effective basis for evaluating strategies for performance improvement.

Goals and Objectives

Goals indicate the desired state of the transportation system according to both agency staff and external stakeholders. While goals are broad, their formation should be given careful consideration and due time because the dialogue and collaboration necessary to identify sound goals lays the groundwork for implementing transportation performance management practices. A transportation agency's goals should reflect the community's vision for the future and tie transportation to wider societal goals such as livability, economic prosperity, and environmental sustainability. Goals that address aspects of the transportation system that people experience directly will resonate with the public (e.g., access to jobs), but the agency must recognize that such outcome-oriented goals are often not fully under agency control. For example, equity and livability are important and resonate with the public, but transportation agencies have limited ability to affect these outcomes among other factors such as economic forces, job growth, and land use/zoning laws.[3]

> "When WMATA asked the Jurisdictional Coordinating Committee (JCC) what the goal "deliver quality service" meant, staff was surprised that "overcrowding" was identified as a concern. WMATA had traditionally viewed crowed platform, trains and buses as a sign of success, but with this feedback, the agency created the objective "Relieve overcrowding."
>
> Source: WMATA staff

Some agencies begin the process of defining goals by first engaging in a visioning exercise. At the same time, staff may draft a mission statement to articulate the core function of the agency (e.g., plan, build, and maintain a transportation system). The resulting paired statements (vision and mission) are often displayed inside agency facilities as a reminder to employees about the ultimate purpose of their activities. Creating vision and mission statements is addressed further in the TPM Guidebook under Organization and Culture (Component A).

Objectives make strategic goals more actionable by breaking down the goals into more specific statements. Defining objectives also provides agencies with the opportunity to ask the public and other external stakeholders, "*what does X goal mean to you?*" Agencies can also use the acronym S.M.A.R.T. (Specific, Measurable, Attainable, Realistic and

[2] Federal Highway Administration (FHWA). (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

[3] National Cooperative Highway Research Program (NCHRP). (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf

Time-bound) to assist them in creating useful objectives. Refer to the *Performance-Based Planning and Programming Guidebook* and Step 1.1.4 below for more information about S.M.A.R.T. objectives.[4]

The FHWA *Performance-Based Planning and Programming Guidebook* states that:

> *A good objective should include or lead to development of a performance measure in order to support decisions necessary to help achieve each goal. Objectives that include specific targets and delivery dates (e.g., reduce pedestrian fatalities by 15 percent from 2010 levels by 2018) are commonly called "SMART" (specific, measurable, agreed-upon, realistic, time-bound).*
>
> *Initially, a State, region, or agency may start out by developing a general objective, which identifies an issue of concern or focus area under a goal area through public and stakeholder outreach. Data and analysis tools used as part of CMP, Transportation Asset Management Plan (TAMP), SHSP or other processes are helpful in first identifying focus areas (understanding what factors are most important in attaining goals).*[5]

Goals and objectives serve as a cornerstone for every subsequent step in the transportation performance management process. In light of this, goals and objectives should reflect certain desired characteristics as discussed in Table 1-1.

Table 1-1: Desired Characteristics of Goals and Objectives

Source: Federal Highway Administration[6]

	Desired characteristics	Rationale/Purpose
Applicable to Goals and Objectives	Attributable to agency	Although many factors influence transportation outcomes, agencies should be able to identify the extent of their role in achieving the goals and objectives.
Applicable to Goals and Objectives	Outcome-oriented	To be relatable to the public, goals and objectives should reflect how the user perceives and interacts with the transportation system.
Applicable to Goals and Objectives	Supported by available data	Data are necessary to track progress toward obtaining goals and objectives.
Applicable to Goals and Objectives	Operational[7]	The overarching purpose of goals and objectives is to guide resource allocation decisions. To evaluate strategies, goals and objectives need to be translatable into performance measures.
Applicable to Goals and Objectives	Reflect Planning Factors[8], National Goals[9]	Supports efforts to comply with regulations.

[4] National Cooperative Highway Research Program (NCHRP). (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf

[5] FHWA. (2013). Performance-Based Planning and Programming Guidebook (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

[6] FHWA. (2013). Performance-Based Planning and Programming Guidebook (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

[7] National Cooperative Highway Research Program (NCHRP). (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf

[8] 23 USC § 134 (h) and § 135 (d)

[9] 23 USC § 150(b)

Applicable to Goals and Objectives	Limited number	A general rule of thumb is to keep goals to <5 and objectives <12. Multiple goals and objectives become too unwieldy to manage and fail to provide focus for an agency. In addition, there is a multiplier effect for each additional goal/objective because a measure needs to be identified for tracking.
Exclusive to Goals	Reflect broad societal concerns	Goals provide the opportunity to demonstrate how transportation affects multiple dimensions of individual lives
Exclusive to Objectives	Specific	Given that goals are broad statements, objectives help agencies "break down" goals into more actionable pieces.

Performance Measures

> "Measures should not be created for the sake of it. Instead, develop the correct measure for the correct purpose and audience."
>
> - Tim Henkel, Minnesota DOT

Once goals and objectives have been defined, performance measures need to be selected to track progress toward attainment,[10] enabling agencies to evaluate their decisions. Careful selection of performance measures is important because the measurement of particular outputs can influence what strategies are employed. For example, if an agency chooses to measure congestion using volume/capacity ratio, strategies to expand capacity (such as road widening) will take preference over more multimodal solutions because capacity-specific activities will have the most impact on this measure. Because measures indicate progress toward meeting goals, agencies could end up focusing more on moving the needle of a specific measure, possibly producing undesirable results.

In addition, measure selection is strongly affected by data availability (see Data Management, Component C and Data Usability and Analysis, Component D). Existing data are the logical place to begin measure development, and often agencies are pushed toward using particular measures because data are already available. The absence of data for areas of public concern like livability can result in a disconnect between how an agency tracks its progress and what external stakeholders care about. Agencies should continually assess what data gaps exist and, over time, make efforts to close those gaps and develop different measures that may be more desired. In the meantime, agencies can use qualitative measures for livability, or can attempt to measure some aspect of livability that serves as a proxy. These challenges should be debated both internally and externally to ensure the best possible list of measures is selected.

Like goals and objectives, measures also have desired characteristics (see Table 1-2). In addition to the characteristics in Table 1-2, the overall number of performance measures should be limited to the "vital few." Measuring everything wastes limited resources because an agency does not have the capacity to incorporate each measure into decision-making. Choosing the "vital few" over the "trivial many" will keep redundant and unimportant measures from obscuring the critical information needed for effective decision-making.[11]

[10] Federal Highway Administration (FHWA). (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

[11] Strategic Highway Research Program 2 (SHRP2). (2009). Performance Measurement Framework for Highway Capacity Decision Making (SHRP2 Report S2-C02-RR). Washington, DC. http://onlinepubs.trb.org/onlinepubs/shrp2/shrp2_S2-C02-RR.pdf

Table 1-2: Desired Characteristics of Performance Measures

Source: National Cooperative Highway Research Program[12]

Desired Characteristic	Rationale/Purpose
Measurable with available tools/data	May require no additional cost for data collection
Forecastable	Enables data-driven target setting based on future conditions
Clear to the public and lawmakers	Allows performance story-telling to customers and policymakers
Agency has influence over result	Measures agency activities rather than impact of external factors

Figure 1-2: Logic Map for the Development of Performance Measures

Source: Federal Highway Administration

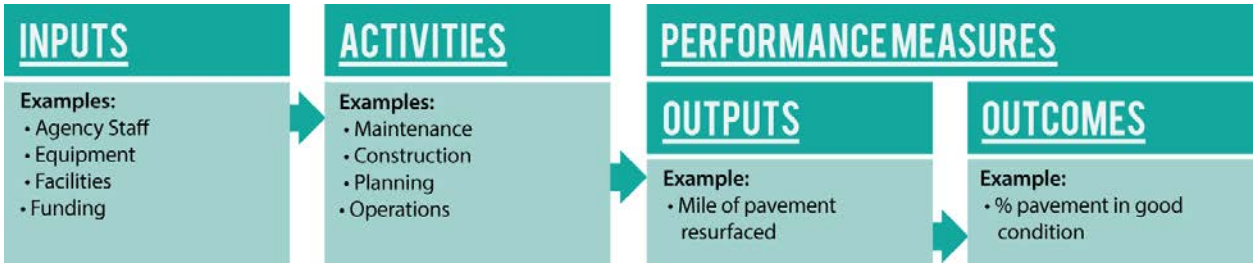
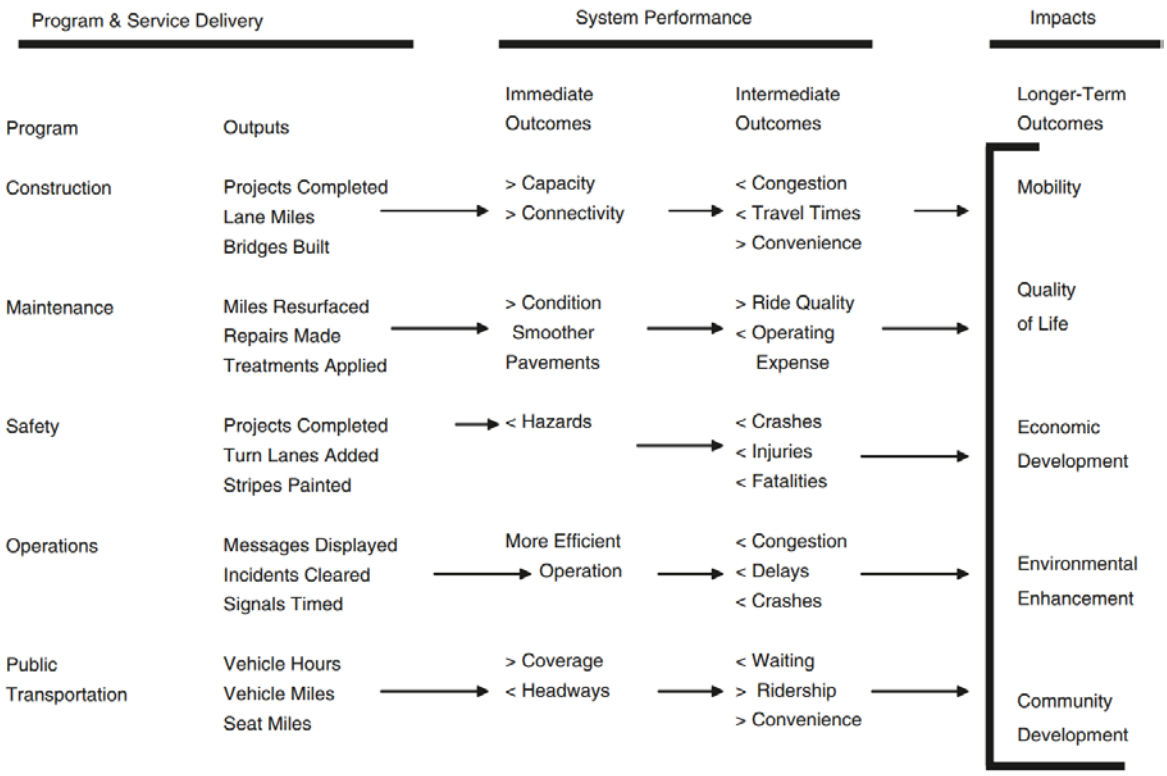


Figure 1-3: Logic Map for the Development of Performance Measures

Source: Performance Measures to Improve Transportation Systems[13]



[12] National Cooperative Highway Research Program (NCHRP). (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf

[13] From *Conference Proceedings 36: Performance Measures to Improve Transportation Systems,* Figure 1, p. 6. Copyright, National Academy of Sciences, Washington, D.C., 2005. Reproduced with permission of the Transportation Research Board.

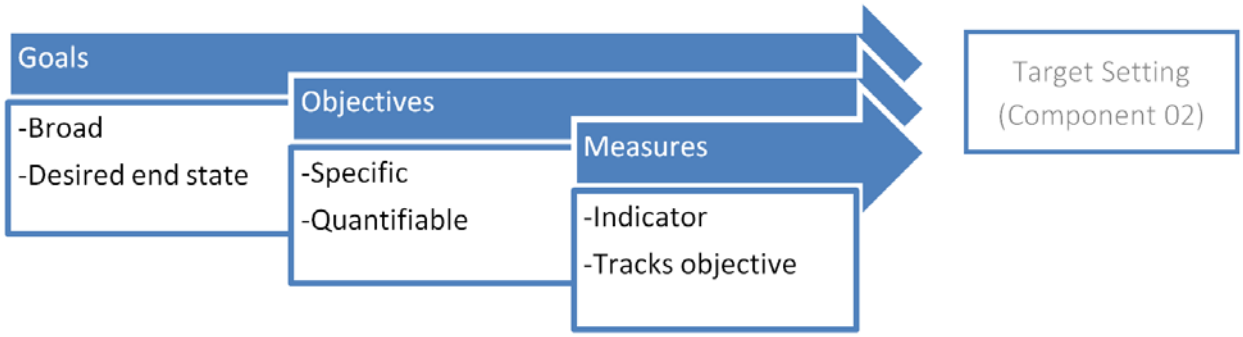
To assist with selecting performance measures, some agencies create a logic map. This can help make the connections between agency staff's day-to-day activities and desired performance results (see Figure 1-2 and Figure 1-3). Output measures assess the level of activity (e.g., miles of pavement resurfaced) and are useful for determining how efficient the agency's budget has been used. In contrast, outcome measures assess effectiveness of an activity. Rather than measure tons of salt applied (an output measure), an agency can measure number of ice-related crashes to gain an understanding of how salt application (an agency activity) impacted public safety through reducing, or not, crash rates due to winter road conditions. A logic map can also serves as documentation of the measure selection process, to promote transparency and repeatability. There are additional factors and challenges to consider when selecting performance measures, which are discussed in detail in the implementation steps below and in Chapter 4 of the Performance-Based Planning and Programming Guidebook.[14]

Outline of Implementation Steps

The establishment of the Strategic Direction is a progression from broad goals, to more specific objectives, to quantitative measures. The example in Figure 1-4 demonstrates the relationship between the different elements addressed in this chapter. An overarching rule of thumb to keep in mind when developing the Strategic Direction is that all three pieces (goals, objectives and measures) need to be defined in a manner that will guide investment decisions and reveal the effect those decisions have on results.[15] Only then can an agency determine how to accomplish the desired outcomes and if those outcomes are in fact being achieved.

Figure 1-4: Formation of Goals and Objectives and Selection of Performance Measures

Source: Federal Highway Administration



Goals, objectives and performance measures are intricately linked, but are treated separately in implementation because each is individually important in creating a strategic direction for transportation performance management. Table 1-3 lists the implementation steps for each subcomponent that will be discussed further in this chapter.

Table 1-3: Strategic Direction Implementation Steps

Source: Federal Highway Administration

Goals and Objectives	Performance Measures
1. Understand the performance context to create a vision	1. Inventory data, tools, and performance reports
2. Build inclusive internal process to develop goals and objectives	2. Engage internal staff and external stakeholders
3. Engage external stakeholders to refine goals and objectives	3. Evaluate potential measures

[14] Federal Highway Administration (FHWA). (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

[15] Federal Highway Administration (FHWA). (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

Goals and Objectives	Performance Measures
4. Evaluate and finalize goals and objectives	4. Establish governance process
5. Document the process	5. Document the process and measure details

CLARIFYING TERMINOLOGY

Table 1-4 presents definitions for the strategic direction terms used in this guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table 1-4: Strategic Direction: Defining Common TPM Terminology

Source: Federal Highway Administration

Common Terms	Definition	Example
Goal	A broad statement of a desired end condition or outcome; a unique piece of the agency's vision.	A safe transportation system.
Metric	An indicator of performance or condition.	The annual number of fatalities.
Mission	Statement that reflects the core functional purpose of an agency.	Plan, build, operate and maintain a safe, accessible, efficient and reliable multimodal transportation system that connects people to destinations and markets throughout the state, regionally and around the world.[16]
Objective	A specific, measurable statement that supports achievement of a goal.	Reduce the number of motor vehicle fatalities.
Outcome	Results or impacts of a particular activity that are of most interest to system users. Focus of subcomponent 5.1 System Level Monitoring and Adjustment.	Transit travel time reliability, fatality rate, percent of assets within useful life.
Output	Quantity of activity delivered through a project or program. Focus of subcomponent 5.2 Program/Project Level Monitoring and Adjustment.	Miles of pavement repaved, miles of new guardrail put into place, the number of bridges rehabilitated, the number of new buses purchased.
Performance Measure	Performances measures are based on a metric that is used to track progress toward goals, objectives, and achievement of established targets. They should be manageable, sustainable, and based on collaboration with partners. Measures provide an effective basis for evaluating strategies for performance improvement.	Transit passenger trips per revenue hour.

[16] Vision and mission examples from: Minnesota Department of Transportation. http://www.dot.state.mn.us/vision/

Common Terms	Definition	Example
Target	Level of performance that is desired to be achieved within a specific time frame.	Two % reduction in fatality rate in the next calendar year.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decision to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.
Vision Statement	An overarching statement of desired outcomes that is concisely written, but broad in scope; a vision statement is intended to be compelling and inspiring.	Minnesota's multimodal transportation system maximizes the health of people, the environment, and our economy.[17]
Visioning	The process of setting or confirming goals and objectives.	Envisioning the characteristics of a transit agency by providing equitable, efficient, and dependable service.

RELATIONSHIP TO TPM COMPONENTS

The ten TPM components are interconnected and often interdependent. Table 1-5 summarizes how each of the nine other components relate to the strategic direction component.

Table 1-5: Strategic Direction Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to the Strategic Direction
02. Target Setting	The use of baseline data, information on possible strategies, resource constraints and forecasting tools to collaboratively establish targets.	Targets turn goals, objectives and measures identified in the strategic direction into statements of success to promote accountability.
03. Performance-Based Planning	Use of a strategic direction to drive development and documentation of agency strategies and priorities in the long-range transportation plan and other plans.	Strategies identified in the planning process define how an agency will achieve goals and objectives. Performance measures provide the means to evaluate/prioritize strategies.
04. Performance-Based Programming	Allocation of resources to projects to achieve strategic goals, objectives and performance targets. Clear linkages established between investments made and their expected performance outputs and outcomes.	The selection of projects is guided by the goals and objectives and measures defined in the Strategic Direction.
05. Monitoring and Adjustment	Processes to track and evaluate actions taken and outcomes achieved that establish a feedback loop to adjust planning, programming, and target setting decisions. Provides key insight into the efficacy of investments.	Information uncovered during the monitoring and adjustment phase helps agencies assess progress toward the goals and objectives defined under the Strategic Direction.

[17] Vision and mission examples from: Minnesota Department of Transportation. http://www.dot.state.mn.us/vision/

Component	Summary Definition	Relationship to the Strategic Direction
06. Reporting and Communication	Products, techniques and processes to communicate performance information to different audiences for maximum impact.	The Strategic Direction is the structure by which the performance story is told, connecting desired and actual results.
A. TPM Organization and Culture	Institutionalization of a TPM culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support TPM.	The Strategic Direction provides a unifying and overarching structure to guide daily activities. The collaborative approach to setting agency goals and objectives builds staff support for the agency's purpose and clarifies how individual employees play a role.
B. External Collaboration and Coordination	Established processes to collaborate and coordinate with agency partners and stakeholders on planning/ visioning, target setting, programming, data sharing, and reporting.	External stakeholder input in creation of the Strategic Direction is essential to clarify what is expected from the agency and to ensure resulting goals, objectives and measures reflect what the public cares about and align with regional priorities.
C. Data Management	Established processes to ensure data quality and accessibility, and to maximize efficiency of data acquisition and integration for TPM.	The Strategic Direction is based on performance condition information across the range of performance areas which in turn is depending on quality data.
D. Data Usability and Analysis	Existence of useful and valuable data sets and analysis capabilities, provided in usable, convenient forms to support TPM.	The availability of data may determine what performance measures are selected within the Strategic Direction, and/or spur new data acquisition.

REGULATORY RESOURCES

This Guidebook is intended to assist agencies with implementing transportation performance management in a general sense and not to provide guidance on compliance and fulfillment of Federal regulations. However, it is important to consider legislative requirements and regulations when using the Guidebook. In many cases, use of this Guidebook will bring an agency in alignment with Federal requirements; however, the following sources should be considered the authority on such requirements:

Federal Highway Administration

- Transportation Performance Management: http://www.fhwa.dot.gov/tpm/links_fhwa.cfm
- Fact Sheets on Fixing America's Surface Transportation (FAST) Act: https://www.fhwa.dot.gov/fastact/factsheets/
- Fact Sheets on Moving Ahead for Progress in the 21st Century (MAP-21): https://www.fhwa.dot.gov/map21/factsheets/
- Resources on MAP-21 Rulemaking: https://www.fhwa.dot.gov/tpm/rule.cfm

Federal Transit Administration

- Fact Sheets on FAST Act: https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-fast-act
- Resources on MAP-21: https://www.transit.dot.gov/regulations-and-guidance/legislation/map-21/map-21-program-fact-sheets

IMPLEMENTATION STEPS

1.1 GOALS AND OBJECTIVES

The following section outlines the steps agencies can follow to develop a set of goals and objectives that establish an agency's strategic direction.

1. Understand the performance context to create a vision
2. Build inclusive internal process to develop goals and objectives
3. Engage external stakeholders to refine goals and objectives
4. Evaluate and finalize goals and objectives
5. Document the process

> "The Bay Area Long Range Transportation Plan has shifted away from traditional goals like 'system preservation' and now fully reflects how transportation agencies can help the region's citizens fulfill their priorities like 'healthy and safe communities.'"
>
> - Dave Vautin, MTC

STEP 1.1.1	Understand the performance context to create a vision
Description	Developing a vision is a useful and productive way for an agency to gain an understanding of the performance context as well as generate buy-in among staff before moving on to goal setting. Before beginning the goal-setting process, staff should assess the current context and have an understanding of how the transportation system is currently performing. This knowledge will help to frame the discussion about long-term transportation trends and needs for the future. Without context, an agency could easily select goals that are irrelevant, unimportant, or already well-addressed, making each subsequent performance-based planning and programming (PBPP) step less effective. A wide array of information will help establish an agency's performance context, including historical and forecast changes in population and employment; current usage by mode; forecasts of expected changes in travel demand; and estimates of current and future transportation system conditions and performance. **Items to keep in mind when developing a vision:** • Examine current performance information to identify high and low performing areas • Obtain understanding of what data exists to track goal/objective achievement • Consider how much control the agency has over a particular outcome • Identify risks that could prevent attainment of goals and objectives • Consider regulatory requirements affecting performance measures
Examples	**Assessment of Existing and Future Demographics, Economics, Climate, Travel Usage and Demand** Understanding historical demographic and economic trends and forecasts help determine the context in which goals and objectives will be developed. Therefore, it is important to incorporate these external factors into the goal/objective-setting conversations (e.g., employment, economic, and industry trends and forecasts; population, households trends and projections, age group, and location). Agencies have also begun to focus on climate forecasts to be better prepared for an increase in frequency and severity of weather incidents. Obtaining this information will likely require partnerships with partners and stakeholders. The following graphics are examples of how agencies have summarized this important information. Figure 1-5 visually illustrates freight movement and commuting habits in Florida. Figure 1-6 displays projected average annual growth for the state of Maryland, by county.

STEP 1.1.1	Understand the performance context to create a vision

Figure 1-5: Florida Freight Movements and Commuting Habits

Source: Florida Transportation Plan Vision Element[18]

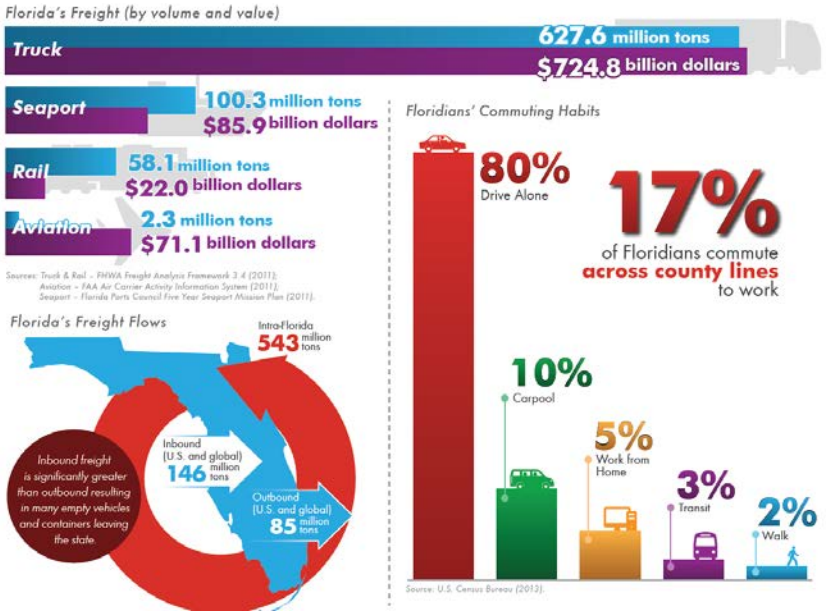
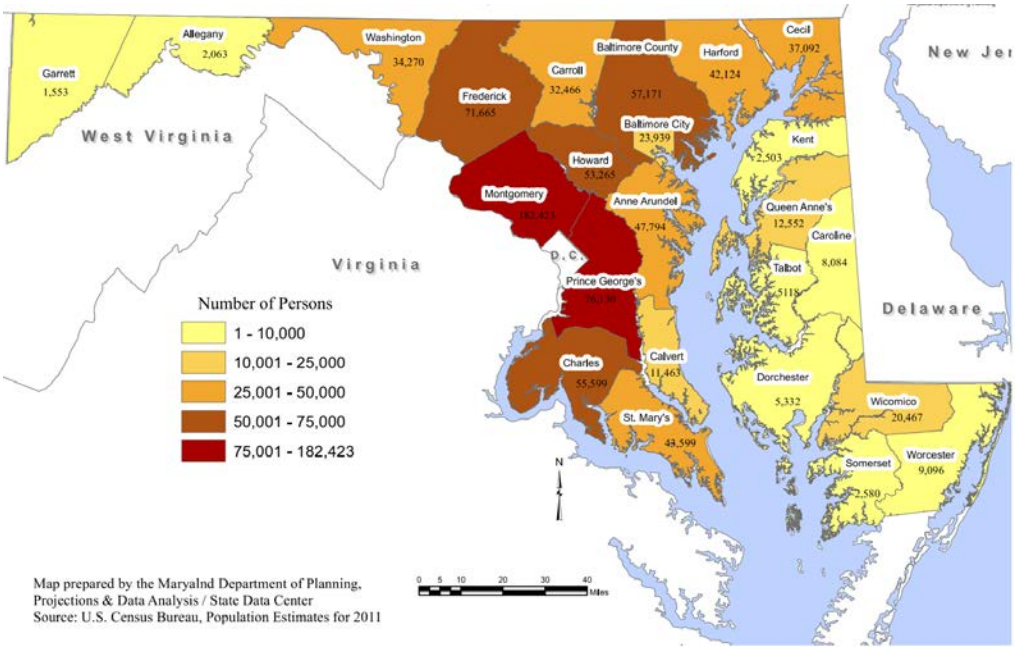


Figure 1-6: State of Maryland Projected Population Growth through 2030

Source: 2035 Maryland Transportation Plan: Moving Maryland Forward[19]



[18] Florida Department of Transportation. (2015). Florida Transportation Plan Element. Tallahassee, FL. http://floridatransportationplan.com/pdf/FDOT_FTP-SIS_VisionElement.pdf

[19] Maryland Department of Transportation. (January 2013). Roundtable Presentation: 2035 Maryland Transportation Plan: Moving Maryland Forward. Baltimore, MD. http://www.mdot.maryland.gov/Office_of_Planning_and_Capital_Programming/Maryland_Transportation_Plan/Documents/MTP_Roundtable_Workshop_Presentation_Final.pdf

STEP 1.1.1	Understand the performance context to create a vision

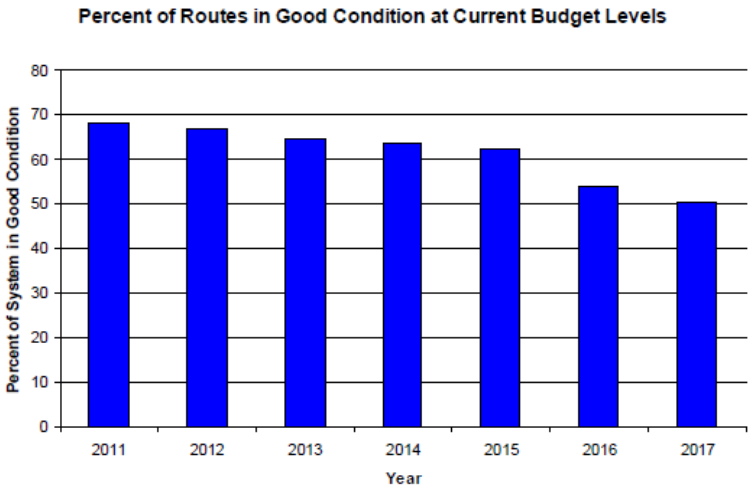
Inventory and Summary of Extent, Condition and Performance of Existing Transportation System

In order to address the external forces shaping transportation in a region, agencies should have a comprehensive understanding of the multimodal transportation system. A comprehensive inventory of existing infrastructure, current condition, and project performance highlight what aspect(s) of their system should be the focus of strategic goals and objectives.

The NCDOT 2040 Challenges and Opportunities Report[20] highlights the need to preserve the health of the state's infrastructure to address mobility and logistic challenges. The assessments of the state highway system condition confirmed that pavement was in need of serious attention. The projection suggests that by 2017, the percent of pavement miles in good condition would drop to 50 percent. The current performance condition and dire projections helped focus the agency's strategic direction on system preservation.

Figure 1-7: Pavement Performance Based on Current Budget in North Carolina

Source: North Carolina Report on the Condition of the State Highway System (2010) [21]



Linkages to Other TPM Components	Component B: External Collaboration and Coordination Component C: Data Management Component D: Data Usability and Analysis (See TPM Framework)

STEP 1.1.2	Build inclusive internal process to develop goals and objectives

Description

With an understanding of the performance context, staff involved up to this point should begin developing an inclusive process to set goals and objectives. This process will inherently build buy-in among others within the agency as long as it is truly inclusive. The shift to a performance-based

[20] North Carolina Department of Transportation. (2011). 2040 Plan Challenges and Opportunities, September 2011. https://www.ncdot.gov/download/performance/2040_challengeopp.pdf

[21] North Carolina Department of Transportation Division of Highways. (2010). 2010 Report on the Condition of the State Highway System. Raleigh, NC. http://www.ncleg.net/documentsites/committees/JLTOC/2011-12_Biennium/Archive/2010-12-14/Presentations/Maintenance_Funding_Needs_Condition_of_Highway_System_DOT_2010_12_10.pdf

STEP 1.1.2	Build inclusive internal process to develop goals and objectives

focus affects the type and amount of work expected of staff, and therefore it is critical to make them aware of such changes from the beginning to ensure a smooth integration of new processes. This is also a time when staff should be informed of the benefits of PBPP and how it will improve agency outcomes. Lack of support across the agency can be a deal breaker, either preventing the process from going forward at all or making the process an empty exercise that will not garner any process changes.

Important actions to take in building internal buy-in:

- **Identify who is involved internally:** promote intra-agency involvement that will enable collaboration between typically isolated silos
- **Ensure inclusivity:** support by staff stems from a feeling of inclusion and ownership
- **Decide who will manage the process**
- **Choose (or be aware of) who will approve the final goals**
- **Ground goals in agency priorities/focus areas:** look at past goals and planning documents as a starting point
- **Engage in a dialogue about the relative priority of different goals**
- **Ensure senior management team uses goal/objective language** to reinforce employees' contribution to agency success and highlight the agency's role in broader societal concerns

Examples

Inclusive goal and objective development can take many forms:

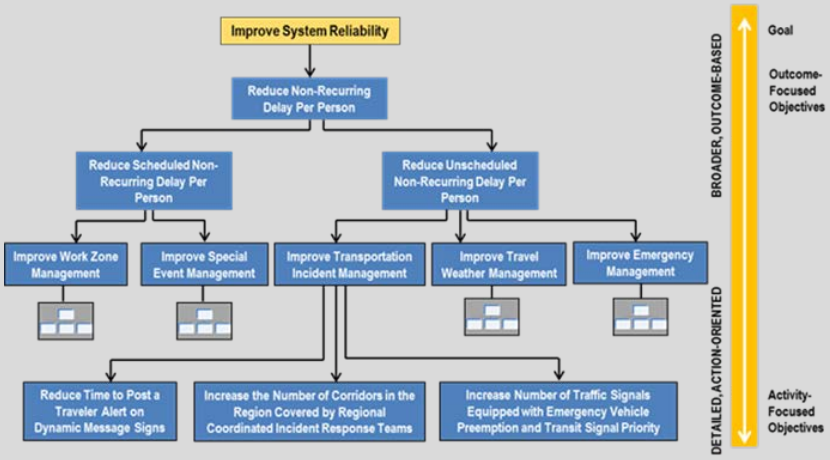
Web-based engagement tool	Staff can write suggestions and provide feedback to draft goals and objectives using an online portal. Executives would review comments and adjust draft list accordingly.
Workshop/ facilitated discussion	Held with various groups across the agency and modeled from external workshops can be used to gather feedback from the public and other stakeholders. Facilitating workshops enable staff to have input in an interactive and engaging way.
SWOT analysis	A way to assess Strengths, Weaknesses, Opportunities, and Threats of potential goals and objectives. With this method, there is ample opportunity for a wide range of topics to be included in the discussion, such as influence of the agency over outcomes and other topics identified in step one.
Tour of preliminary goals	A small group within the agency can develop a draft list of goals and objectives for review by the staff at large. The small group may provide a webinar or short seminar to orient other staff before gathering feedback. Feedback from the broader staff can be used to evaluate the draft goals and objectives to create the final list.
Objective Tree	A transportation agency can select which objectives in the objectives tree are most important to be included in the LRTP or other planning documents. This

STEP 1.1.2	Build inclusive internal process to develop goals and objectives

can be seen below or viewed in the Performance Based Planning and Programming Guidebook.[22]

Figure 1-8: FHWA Objective Development

Source: Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations[23]



Linkages to Other TPM Components	Component A: Organization and Culture	(See TPM Framework)

STEP 1.1.3	Engage external stakeholders to refine goals and objectives

Description

Once internal buy-in is solidified and staff understands their role in the process, those outside the agency must be asked for their input. These groups include the public at large as well as other agencies and organizations; identifying which organizations and groups should be involved sets the stage for obtaining their input, which is critical to keeping the agency relevant.

- How do the agency's activities support regional priorities?
- How do the initial goals and objectives drafted through internal engagement align with to external goals?

These questions can only be answered if asked to a broad and diverse cross-section of the community. Stakeholder engagement is also an opportunity for the agency to clarify the linkage between core agency functions and broader societal concerns and discuss the relative priority of different goals. Input from stakeholders should be used to refine goals and objectives so that they resonate outside of the agency. Given that goals determined within the Strategic Direction process will guide all agency work, effective engagement of external stakeholders is a key step.

In addition to making the goal-setting process more relevant, external engagement is also required under 23 USC § 134 (i)(6) and 23 USC § 135 (f)(3), as well as 49 USC § 5303 (i)(6) and 49 USC § 5304 (f)(3) as part of transportation plan development. Any interested parties should

[22] Federal Highway Administration (FHWA). (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

[23] Federal Highway Administration and Federal Transit Administration. (2010). Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference. http://www.ops.fhwa.dot.gov/publications/fhwahop10027/fhwahop10027.pdf

STEP 1.1.3	Engage external stakeholders to refine goals and objectives

be included, as well as the general public, transportation providers, and representatives of system users.[24] Other agencies and governments, including Federal and Tribal, must be consulted as well. Metropolitan Planning Organizations (MPOs) developing the Metropolitan Transportation Plan must consult, as appropriate, "State and local agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation."[25] States developing the LRTP must consult with MPOs, regional transportation planning organizations (RTPOs), tribal governments, and applicable Federal, state and local agencies.[26]

Items to keep in mind:

- Identify who is to be involved externally
- Connect draft goals and objectives to regional priorities (ask stakeholders: "what does X goal mean to you?")
- Clarify the linkage between core agency functions and broader societal concerns
- Consider National Goals and Planning Factors when discussing priorities
- Discuss the relative priority of different goals
- Refine goals and objectives so that the language resonates with stakeholders

Examples

Binghamton Scenario Planning[27]

Spurred by a declining population and the need to update the LRTP, the Binghamton Metropolitan Transportation Study (BMTS), the MPO for the Binghamton, NY region, undertook an extensive external engagement process to identify community goals. Their first step was to create a Community Vision Team that included a representative cross-section of the community:

- Students and administrators from Binghamton University
- Human service providers
- Elected officials
- Business and economic development representatives
- BMTS staff

Facilitators presented the team with summaries of goals from local planning and economic development documents to discuss in a series of meetings. While there were some challenges in keeping all members of the team continuously engaged, the biggest challenge was convincing local elected officials and planning staff from different agencies to participate in a cooperative dialogue.

The previous LRTP lacked a clear community vision, but the updated plan reflects the goals proposed by the Community Vision Team, emphasizing how external engagement can link community goals to agency planning. In a reminder that internal buy-in is also critical, those involved noted that success hinged on the support of the MPO leadership who approved a departure from traditional methodology.

[24] 23 USC § 134 (i)(6) and 23 USC § 135 (f)(3)
[25] 23 USC § 134 (i)(5)
[26] 23 USC § 135 (f)(2)
[27] FHWA PlanWorks Application. *Binghamton Metropolitan Transportation Study: Scenario Planning Yields Community Vision of Revitalized Urban Centers*. https://fhwaapps.fhwa.dot.gov/planworks/Reference/CaseStudy/Show/23.

STEP 1.1.3	Engage external stakeholders to refine goals and objectives

MTC PlanBayArea 2040

The Metropolitan Transportation Commission, the MPO for the San Francisco Bay Area, is currently updating its Regional Transportation Plan (RTP), known as Plan Bay Area 2040. To engage external stakeholders, MTC assembled a Performance Working Group comprised of representatives from cities; counties; transit agencies; congestion management agencies; the state; economic, equity, and environmental organizations; and members of the Policy Advisory Committee, made up of citizen representatives. This comprehensive group was engaged to develop goals and performance targets for the plan update.

To inform the working group, staff led public workshops during which goals from the original Plan Bay Area (adopted in 2013) were presented as a starting point; attendees voted for their top three most important. Once voting was complete, individuals were asked what goals were missing and wrote their ideas on sticky notes to assemble on the wall. This low-tech word cloud was assembled into the digital version shown here, with word size indicating the relative number of comments posted by participants.[28]

Figure 1-9: MTC Collaborative Goal Setting

Source: Plan Bay Area 2040 Spring 2015 Public Engagement Report[29]

Water was a top goal area because of the ongoing drought. MTC staff noted that social equity, in terms of affordable housing, was elevated as a major concern in this RTP cycle, while economic vitality was a lower priority because of the strength of the area's economy. This engagement process demonstrated how important it is for an agency to engage stakeholders on an ongoing basis because priorities can and do shift based on changing conditions. Staff also noted that stakeholder understanding of the impact of this process has increased each cycle; selection of goals can be contentious because stakeholders know that plan goals do in fact determine which projects are funded and how discretionary funding is allocated.

[28] Metropolitan Transportation Commission and Association of Bay Area Governments. (2015). Plan Bay Area 2040 Spring 2015 Public Engagement Report. http://planbayarea.org/file10232.html

[29] Metropolitan Transportation Commission and Association of Bay Area Governments. (2015). Plan Bay Area 2040 Spring 2015 Public Engagement Report. http://planbayarea.org/file10232.html

STEP 1.1.3	Engage external stakeholders to refine goals and objectives
Linkages to Other TPM Components	Component B: External Collaboration and Coordination (See TPM Framework) Component 03: Performance-Based Planning

STEP 1.1.4	Evaluate and finalize goals and objectives
Description	After a set of goals and objectives has been assembled, the list must be adjusted so each goal reflects the desired characteristics discussed in the introduction to this chapter. If the external stakeholder engagement step was done well, the goals will likely already be outcome-oriented and relatable to the public. External engagement will also align initial goals with areas of key public concern. While these two characteristics may already be reflected in the agency's initial goals, the National Planning Factors and Goals should also be considered. In addition, the agency should clarify the relative priority of each goal to set a clear strategic direction. As a result of this process, performance measure will start to become clearer. As referenced in the introduction of this component, agencies may opt to use S.M.A.R.T. objectives. These objectives align with the principles listed here: • Specific: The objective includes enough specificity to allow formation of strategies that will enable attainment without dictating said strategies. • Measurable: The objective is quantifiable. • Agreed: The objective is valid and important, as judged by stakeholders. • Realistic: The objective can be attained with available resources and within particular political, economic, and other contexts. • Time-Bound: The objective identifies a timeframe for attainment. Refer to the Performance-Based Planning and Programming Guidebook[30] for more information about S.M.A.R.T. objectives. **Desirable characteristics of goals and objectives (see Table 1-1):** • Attributable to agency • Outcome-oriented • Supported by available data, or by data that can be easily acquired or collected • Operational • Reflects Planning Factors, National Goals • Limited in number • Reflects broad societal concerns (goals only) • Specific (objectives only)
Examples	Final goals and objectives will be unique to each agency but below is an example of how Champaign Urbana Urbanized Area Transportation Study (CUUATS) aligned its objectives with national goals, Illinois State Transportation Policy Factors, and the updated LRTP title Sustainable Choices 2040.

[30] Federal Highway Administration (FHWA). (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

STEP 1.1.4	Evaluate and finalize goals and objectives

Goal: Increase accessibility and mobility of people and freight

Table 1-6: CUUATS S.M.A.R.T. Goals Addressing Accessibility

Source: Champaign Urbana Urbanized Area Transportation Study[31]

Draft Objectives	Elements of S.M.A.R.T. Objectives
Develop pedestrian plans for all jurisdictions within the urbanized area by 2020.	Defining "by 2020" for when the objective is completed supports the time-bound requirement of S.M.A.R.T. objectives.
Develop snow removal ordinances, programs, and policies for all jurisdictions to provide year-round access to sidewalks, bike paths, and transit stops	Providing particular examples of how an objective is completed, such as "snow removal on sidewalks, bike paths" supports the specific feature of S.M.A.R.T.

Goal: Transportation for underserved populations such as elderly, low-income, and persons with disabilities

Table 1-7: CUUATS S.M.A.R.T. Goals for Underserved Demographics

Source: Champaign Urbana Urbanized Area Transportation Study[32]

Draft Objectives	Elements of S.M.A.R.T. Objectives
Upgrade existing sidewalk network within the urbanized area by 10% to be ADA-compliant	Identifying a 10% increase affirms the specific and realistic characteristics of S.M.A.R.T. objectives.
Improve below-average scores in five planning areas identified by the Local Accessibility and Mobility Analysis	Defining five planning areas can easily be assessed to fulfill the measurement feature of S.M.A.R.T.

Goal: Address issues of equity as well as segregation in diverse communities in the area of transportation

Table 1-8: CUUATS S.M.A.R.T. Goals for Addressing Social Inequity and Segregation in Diverse Communities

Source: Champaign Urbana Urbanized Area Transportation Study[33]

Draft Objectives	Elements of S.M.A.R.T. Objectives
Provide at least one opportunity for public input for each new transportation project	Providing opportunity for public input accomplishes the agreement aspect of a S.M.A.R.T. objective.
Make information materials on transportation modes, facilities, and /or benefits available in at least one language besides English	

[31] Champaign County Regional Planning Commission. (2013). Champaign Urbana Urbanized Area Transportation Study - 2040 Vision - Goals, Objectives, & Performance Measures. Urbana, IL. http://lrtp.cuuats.org/wp-content/uploads/sites/2/2016/03/LRTP-Main_011615_reduced_9-Goals-etc.pdf

[32] Champaign County Regional Planning Commission. (2013). Champaign Urbana Urbanized Area Transportation Study - 2040 Vision - Goals, Objectives, & Performance Measures. Urbana, IL. http://lrtp.cuuats.org/wp-content/uploads/sites/2/2016/03/LRTP-Main_011615_reduced_9-Goals-etc.pdf

[33] Champaign County Regional Planning Commission. (2013). Champaign Urbana Urbanized Area Transportation Study - 2040 Vision - Goals, Objectives, & Performance Measures. Urbana, IL. http://lrtp.cuuats.org/wp-content/uploads/sites/2/2016/03/LRTP-Main_011615_reduced_9-Goals-etc.pdf

STEP 1.1.4	Evaluate and finalize goals and objectives
Linkages to Other TPM Components	Component 06: Reporting and Communication (See TPM Framework) Component B: External Collaboration and Coordination

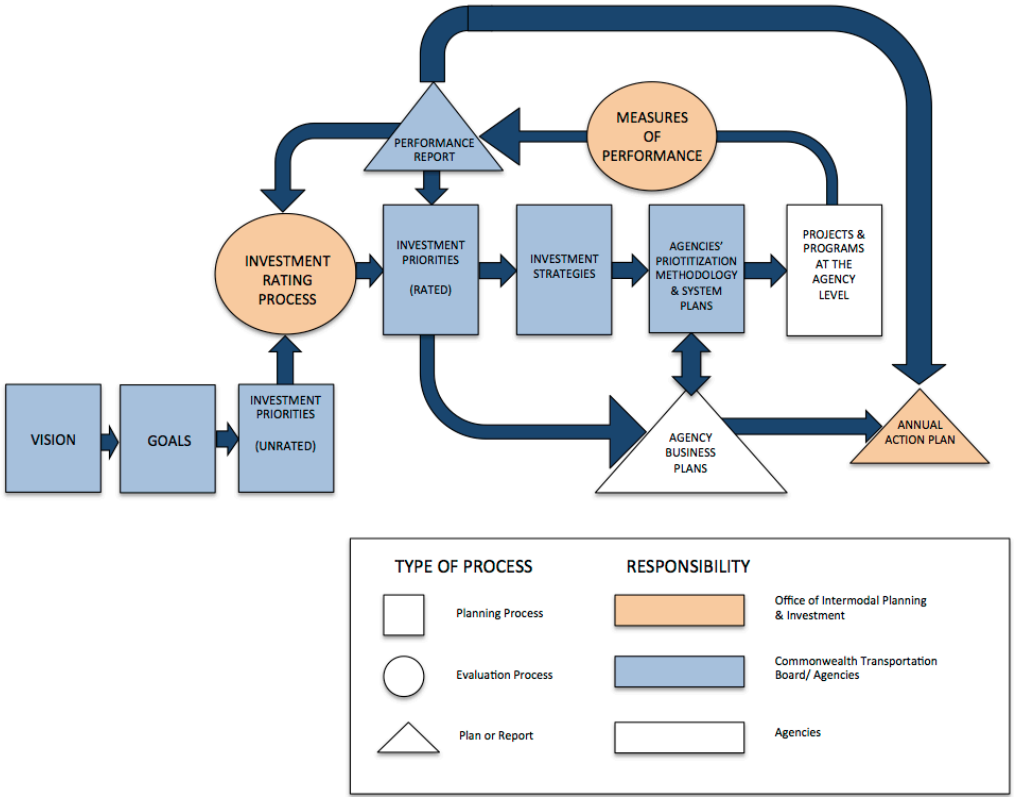
STEP 1.1.5	Document the process
Description	Because the goals and objectives selected through this process will drive agency priorities, the selected set of goals and objectives should be reevaluated on a regular basis to ensure that the agency is maintaining focus on the most important areas according to both internal staff and external stakeholders. To make the process simpler and easier in the future, information about how each step was completed the first time around should be documented in detail. It is important to distribute this documentation internally and externally as appropriate to promote transparency and accountability as well as build internal buy-in among staff. While there is no Federal requirement to document these steps, some of the steps themselves are required by Federal law, such as external outreach/engagement. In addition to making the external engagement process easier the next time goals and objectives are reevaluated, it may make sense to document how this step was undertaken to make it clear that the Federal requirement to engage external stakeholders was in fact met. **Documentation should:** • Outline coordination of goals across planning documents • Explain how goals and objectives will be used in planning, programming, and employee performance evaluations • Describe who fulfilled roles and responsibilities throughout the process • Detail how each step was undertaken, and the result of each step
Examples	**Virginia VTrans2035 Update** The update to VTrans2035 seeks to link projects to VTrans Goals by describing how goals will permeate through the later planning and programming processes. As measurable statements, Investment Priorities are analogous to Objectives. In each cycle, Investment Priorities are rated based on performance measures (which indicate need) and cost-effectiveness. Investment Strategies are key tactics that modal agencies can implement through plans and programs to achieve Investment Priorities and therefore drive attainment of Goals. Specific projects from state and regional plans are linked to Goals through the succession of Investment Priorities and Investment Strategies. The diagram below shows how the VTrans2035 LRTP documents how Goals impact the planning and programming processes.[34] "Agency processes such as needs evaluations, performance rating, and project prioritization can be shaped in terms that relate directly to VTrans. This consistency… promotes the alignment among policies, plans, and funding programs that is necessary to gauge accurately the effects of transportation decisions on system performance." Source: Commonwealth Transportation Board. (February 2013). *VTrans2035 Update: Executive Summary.*

[34] Commonwealth Transportation Board. (2013). 2035 Update, VTrans: An Update to Virginia's Statewide Multimodal Long-Range Transportation Policy Plan. http://www.vtrans.org/resources/VTrans2035Update_Final_Draft_with_Appendices.pdf

STEP 1.1.5	Document the process

Figure 1-10: VTrans2035 Investment Priority Planning Process

Source: Adapted from 2035 Update, VTrans[35]



Vermont Agency of Transportation (VTrans)

VTrans describes both external and internal engagement in developing its Long Range Transportation Business Plan. A public opinion survey was commissioned to determine public priorities for projects, services, and other agency outputs and the results were compared to a previous survey conducted in 2000. In addition to external input, the Vtrans has an Internal Working Group that comments on draft objective language. Final objectives provide the framework by which planning and programming strategies will be developed. When drafting goal statements, Executive leadership obtained input from VTrans staff and solicited input for draft objective language. The current LRTBP identifies multiple policy options for each objective based on a variety of future scenarios, setting it apart from past plans and making it clear that the process is dynamic.[36]

Linkages to Other TPM Components	Component A: Organization and Culture	(See TPM Framework)
	Component B: External Collaboration	

[35] Commonwealth Transportation Board. (2013). 2035 Update, VTrans: An Update to Virginia's Statewide Multimodal Long-Range Transportation Policy Plan. http://www.vtrans.org/resources/VTrans2035Update_Final_Draft_with_Appendices.pdf

[36] Vermont Long Range Transportation Business Plan. June 7, 2016. http://vtransplanning.vermont.gov/reports/lrtbp

1.2 PERFORMANCE MEASURES

From the goals and objectives approved in subcomponent 1.1, the agency chooses performance measures to track progress toward attainment. Another important result of the performance measure selection process is the establishment of a governance process that can be used to assess, modify, and add measures in the future, allowing an agency to continuously refine its transportation performance management program.

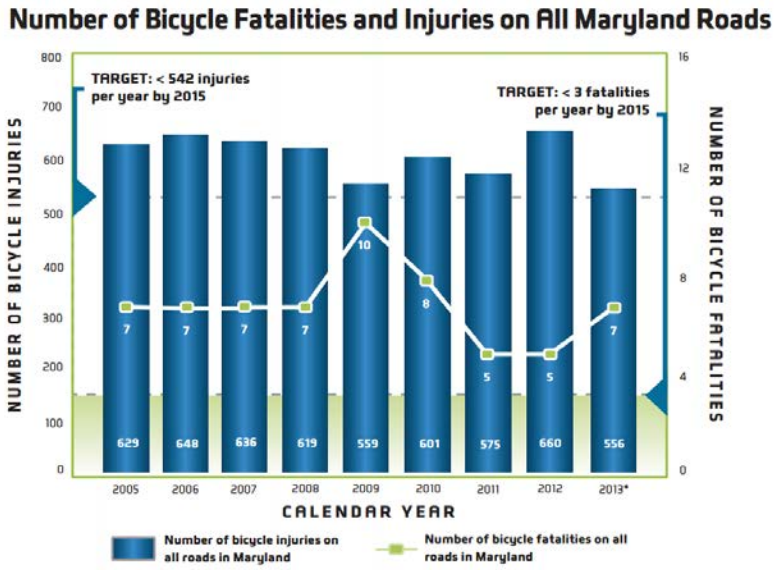
1. Inventory data, tools, and performance reports
2. Engage internal staff and external stakeholders
3. Evaluate potential measures
4. Establish governance process
5. Document the process and measure details

> "Why do we look at performance information? It is pretty simple. We are investing money in our transportation system and want to know what we get for it. Performance measures let us understand the relationship between investments and results."
>
> - Camelia Ravanbakht, Hampton Roads Transportation Planning Organization

STEP 1.2.1	Inventory data, tools, and performance reports
Description	Similar to step 1.1.1, some groundwork should be done to understand where the agency stands in terms of data, tools, and performance reports. Selection of measures will depend on whether the agency has existing data to support the measure, or whether there is capacity to collect or acquire new data. However, the existence of data does not guarantee its usability for this new purpose. Many agencies have a wealth of data, but do not have systems in place to create usable information from it. Knowing the state of data will help define the scope of the measure selection process; agencies with well-established systems that allow for data usability can choose measures directly related to those data streams. Agencies with less well-developed data management should scale back their measure selection process to make it more manageable. It may make more sense to select just a few measures with the data that is currently usable and expand at a later date once more data are available. However, some agencies may choose to use this measure selection process as an impetus for tackling problems associated with data, whether it is a lack of it, or a lack of usability. It is also important that forecasting tools exist related to the data and measures. Without a method to forecast future conditions, it will be very difficult to complete Target Setting (Component 02) processes. Finally, performance reports contain potential measures that are proven to have all the necessary elements discussed above. While it will be important to evaluate them for usefulness under the goal areas selected in subcomponent 1.1, they provide a starting point for discussion. Performance reports will also support the target-setting process (Component 02) by providing information on current performance levels. • Identify and document data owner and source • Consider whether data are useful and reliable in its current form • Contemplate tackling data usability and reliability issues • Inventory forecasting tools • Use performance reports as discussion starter

STEP 1.2.1	Inventory data, tools, and performance reports
Examples	**DDOT Measure Development** Prompted by language in the comprehensive plan, the District of Columbia Department of Transportation attempted to develop a new measure termed person through-put. The comprehensive plan tasked DDOT to reduce reliance on level of service as a primary evaluation tool; the organization desired a broader set of measures that would capture more information when measuring the movement of people. It was not intended that level of service be eliminated, but rather additional measures would be included alongside. Person through-put proved difficult to develop. The agency struggled with its definition and whether it would be useful as developed. The measure relied on travel modeling, which introduced issues of data quality and accuracy of prediction outputs from coarse tools such as a travel demand model. Staff produced more accurate predictions using a microsimulation, but concluded that it would be prohibitively expensive for regular use in planning. When applied to a study for an exclusive transit lane on Georgia Ave, the person through-put measure did not clearly indicate whether improved transit would move enough people to compensate for those in vehicles displaced by the transit lane. DDOT staff learned valuable lessons that other agencies should consider when beginning the measure selection process. • Developing new measures takes significant thought. • Many staff began the process expecting it to be relatively straightforward, but found it to be complex and difficult. • Existing measures like level of service are used for a reason – they are easy. • Linkages between data, tools, and measures are not necessarily clear. For agencies starting down the path of transportation performance management for the first time, it may make sense to use measures that are well-established so that time will be spent on measures known to be easily usable. However, it is important that agencies critically analyze the limitations of existing measures.
Linkages to Other TPM Components	Component C: Data Management Component D: Data Usability and Analysis (See TPM Framework) Component 06: Reporting and Communication

STEP 1.2.2	Engage internal staff and external stakeholders
Description	Once the agency understands which data are usable and what current performance levels are, the process of engagement can begin. Both agency staff and external groups should be consulted when developing measures. Obtaining input from various groups will expedite the evaluation process in the next step when determining if the public and other external groups can easily understand a particular performance measure. This will also be important when reporting results, covered in depth in Component 06: Reporting and Communication. Internal staff should, now that they understand the performance context, be able to determine whether certain measures are forecastable or measurable with existing tools and data. This combination of internal technical understanding and external, generalist perspective will ensure that a useful set of initial measures is developed in this step.

STEP 1.2.2	Engage internal staff and external stakeholders
	Items to keep in mind: • Ensure a diverse group of stakeholders is invited to participate • Engage technical and nontechnical individuals
Examples	**External Stakeholders: Maryland Attainment Report Advisory Committee** As of 2000, Maryland law requires publication of an annual Attainment Report that includes performance indicators to track progress toward achievement of goals and objectives in the Maryland Transportation Plan (LRTP) and the Consolidated Transportation Program (6-year capital budget).[37] The law was updated in 2010 to create an Attainment Report Advisory Committee comprised of specific stakeholders such as: • A representative of rural interests • A representative of an auto-users' group • A representative of a transit-users' group • A nationally-recognized expert on pedestrian and bicycle transportation • A nationally-recognized expert on transportation performance management • And others The committee is charged with reviewing use of performance measures in other states to advise MDOT on goals, benchmarks, and performance measures. An example of such a measure is below. MDOT staff as well as staff from the modal administrations within the department work with the committee to develop performance measures each time Maryland's long-range plan is updated, or every three years. **Figure 1-11: Measuring Safety for Bicycle and Pedestrians at MDOT** Source: 2015 Annual Attainment Report[38] 

[37] Transportation Article Section 2-103.1 of the Annotated Code of Maryland.

[38] Maryland Department of Transportation. (2015). 2015 Annual Attainment Report. http://www.mdot.maryland.gov/Office_of_Planning_and_Capital_Programming/CTP/CTP_15_20/CTP_Documents/2015_Final_AR.pdf

STEP 1.2.2	Engage internal staff and external stakeholders
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework) Component B: External Collaboration and Coordination

STEP 1.2.3	Evaluate potential measures
Description	What gets measured gets managed, so it is important to select performance measures thoughtfully. An agency should consider the characteristics discussed in the introduction to this chapter and listed in Table 1-2. Selected measures will have a strong impact on agency priorities because they will be tracked and reported. A classic example is congestion measures, whereby choosing to measure volume/capacity ratio will push the agency toward capacity solutions such as roadway expansion. While this could be acceptable to an agency, this likely result should be understood during the selection process and weighed against other potential measures such as person-hour delay that may allow for more multimodal solutions. Measures can push agencies away from their stated goals if they favor undesirable solutions as the only way to move the needle. The evaluation process feeds into the next step of establishing a governance process. To streamline the next steps and future iterations of the process of setting up the strategic direction, it is important to record how measure selection was conducted, what was decided, and why. **Items to keep in mind:** • Consider the desirable characteristics in Table 1-2. • What type of solutions will a particular measure push the agency toward? • Do measures create potential conflicts? • Create a user-friendly and standard form for evaluation.
Examples	**WisDOT Measures Profile** The Wisconsin DOT (WisDOT) uses an extensive spreadsheet to assess potential measures; factors include a one to five rating of measure reliability, how often data are collected, who is responsible for the measure, and unit of measure. Each measure is listed according to the goal it seeks to measure. The spreadsheet has been designed for ease of use with pop-out info boxes that further explain particular factors. It is important that the process is as robust as possible, while also being simple and straightforward for the user. WisDOT's spreadsheet also tracks measures by year and lists the performance target for each measure, allowing the same document to be used for evaluation of potential measures as well as for recording progress toward attaining targets.

STEP 1.2.3	Evaluate potential measures

Figure 1-12: Performance Measure Evaluation at WisDOT

Source: Wisconsin Department of Transportation[39]

K	L	M	N	O	P	Q	R	S
Singular metric or analytic (index) measure?	**Degree of reliability (1 worst - 5 best)**	**Degree of validity (1 worst - 5 best)**	**Data Frequency**	**Data Timing**	**Information Source(s)**	**Data Element(s)**	**Measure Calculation Formula(e)**	**Steering Team Member**

Maricopa Association of Governments (MAG)

MAG uses the following matrix to visualize data availability for potential measures. Measures are arranged according to mode and focus area and are identified as system, corridor, or segment level measures. Data availability is indicated by the color of the cell; yellow indicates data are available, orange indicates partial data are available/refinement is needed for usability, and red indicates that no data are available or significant refinement is necessary. This "road map matrix" method clearly demonstrates at a glance which focus areas and modes are lacking in usable measures, assisting the agency in refining measures through further development of the Transportation Performance Management Program.

Figure 1-13: Maricopa Association of Governments Measure Evaluation Matrix

Source: Maricopa Association of Governments[40]

Focus Area/Mode	Limited Access Highways (GP)	HOV Lanes	Arterials	Transit
Travel Time, Delay & Reliability	Mean and 80th-95th percentile & point-to-point travel times	Mean and 80th-95th percentile & point-to-point travel times	Mean and 80th-95th percentile & point-to-point travel times (PSSD)	Point-to-point travel times
	Congestion - spatial and temporal (FMS)	Congestion - spatial and temporal (FMS)	Congestion - spatial and temporal	Congestion - spatial and temporal
	Travel time reliability index [buffer index]	Travel time reliability index [buffer index]	Travel time reliability index [buffer index]	On-time performance (peak period and overall)
	Congestion/Delay - speed based (PSSD)		Congestion/Delay - speed based (PSSD)	
	Travel time index and planning time index (PSSD)		Travel time index and planning time index (PSSD)	
	Avg Trip length by mode			Avg Trip length by mode
	Lost Productivity			

Linkages to Other TPM Components

Component B: External Collaboration and Coordination (See TPM Framework)

Component C: Data Management

Component D: Data Usability and Analysis

[39] Wisconsin Department of Transportation. Performance Measure Evaluation. Madison, WI. Courtesy of Lori Richter.

[40] Maricopa Association of Governments. 2016. Phoenix, AZ.

STEP 1.2.4	Establish governance process
Description	With final measures approved, the agency is then ready to document the process and move to target setting. However, the performance measures selection process is not a one-off activity; measures should be continually assessed and modified. A governance process must be created to manage these adjustments to ensure changes reflect the needs of the agency and external stakeholders, data constraints, and other factors. **Important questions to ask:** • Obtain internal feedback from different users across the agency: will the selected measures support decision-making? • Gather feedback from external stakeholders on higher-level measures: do they resonate? • Consider gaps: what does the agency want to measure, but can't, because of data limitations? What new data sources are in the pipeline? From answers to the above questions, the agency should adjust selected measures, develop supplementary measures that will provide additional support for decision-making, and explore the feasibility of collecting new data to fill gaps. Data may already be collected, but are not in an accessible or usable form; consider options to make such data useful for decision-making.
Examples	The **Strafford MPO**, which covers the Dover-Rochester-Berwick, ME urbanized area in New Hampshire and Maine, has a well-defined performance measure governance process. Initial measure selection considers a number of factors as shown below.[41] The Policy and Technical Advisory Committees[42] comprise representatives from a number of external stakeholders including NHDOT, local municipalities, the University of New Hampshire, and FHWA. In addition to input from these committees, SMPO considers data/resource constraints, statutory requirements, and its own goals and objectives. With selected measures, targets are set and incorporated into the planning process. The dynamic nature of SMPO's process is depicted with the feedback arrow that spans the full length of the performance measure selection process as well as target setting and planning.

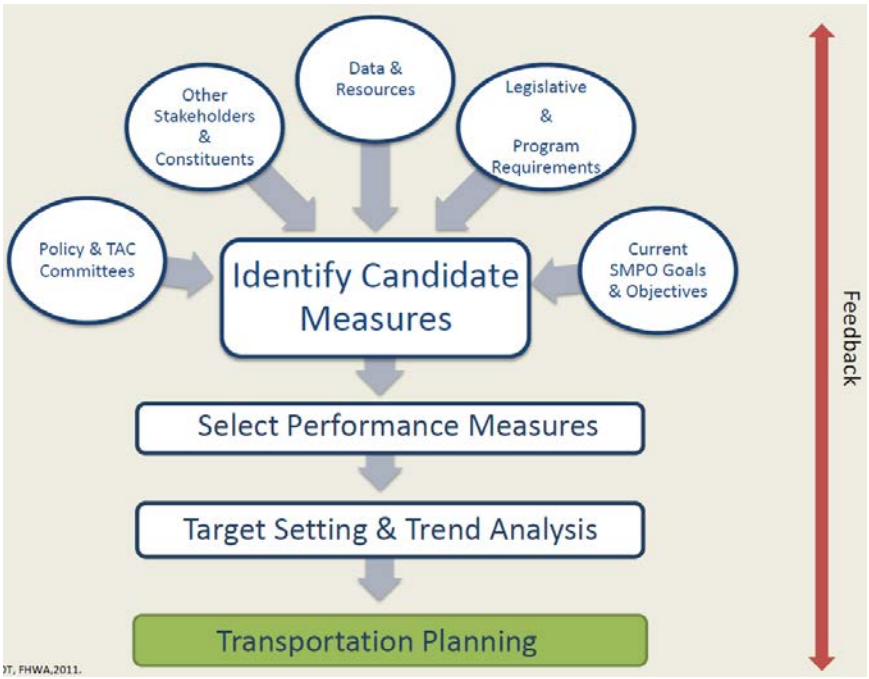
[41] Performance Based Transportation Planning. Presentation November 21, 2014. http://www.strafford.org/cmsAdmin/uploads/policy-11-21-2014-meeting-presentation_with_notes.pdf

[42] Policy Advisory Committee. http://www.strafford.org/transportation/mpo_policycomm.php. Technical Advisory Committee. http://www.strafford.org/transportation/mpo_tac.php

STEP 1.2.4	Establish governance process

Figure 1-14: Strafford MPO Performance Measure Governance Process

Source: Performance Based Transportation Planning Presentation[43]



Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework) Component B: External Collaboration and Coordination Component C: Data Management Component D: Data Usability and Analysis

STEP 1.2.5	Document the process and measure details

Description

Like the goal selection process, the measure selection process should be documented to streamline future iterations. However, for performance measures, it is vital to document the measures themselves including how they are calculated, what data sources they use, and other details. Among other reasons, it will prevent inaccurate comparisons among agencies that use a measure of the same name but different underlying calculations.

Step 1.2.1 directly feeds into documentation. All of the information collected in the inventory of data, tools, and performance reports should be recorded in this step for future reference.

Document:

- Data owner and source
- Measure calculations
- Final selection of measures
- How to identify and close performance measurement gaps

[43] Strafford Regional Planning Commission. (2014). Performance Based Transportation Planning Presentation. Rochester, NH. http://www.strafford.org/cmsAdmin/uploads/policy-11-21-2014-meeting-presentation_with_notes.pdf

STEP 1.2.5	Document the process and measure details

Examples

WMATA On-Time Performance Comparison

When the Board of the Washington Metropolitan Area Transit Authority wanted to compare bus on-time performance (OTP) with other agencies, staff found such a comparison to be a challenge. No industry standard exists for measuring and reporting this metric, yet many agencies use the same name: bus on-time performance. It is impossible to precisely compare one agency to another with widely varying parameters of what is considered late or on time. Figure 1-15 summarizes a few agency parameters for OTP. WMATA (listed as Metro in Figure 1-15) defines on-time performance as the "difference between scheduled time and actual time arriving at a time point based on 2 minutes early/7 minutes late parameters."[44]

While it may seem clear from Figure 1-15 which agency has the most rigorous definition of OTP, there is another aspect of this performance measure that must be noted; agencies also record bus arrivals in differing ways. Some agencies like Miami-Dade Transit include every stop on a route, but do not include departure and arrival at garages. MARTA only measures departures.

Figure 1-15: Comparing Public Transportation Performance Measures

Source: Bus Performance Board Nov. 2010[45]

AGENCY	EARLY	LATE
Metro *Schedule Adherence	2 minutes	7 minutes
Ride On * Schedule Adherence	2 minutes	5 minutes
DC Circulator *Headway Adherence (<15 mins. is late)	7 minutes	11 minutes
The Bus * Schedule Adherence	2 minutes	7 minutes
CUE *Schedule Adherence	2 minutes	5 minutes
SEPTA *Schedule Adherence	0 minutes	4 minutes
MDT * Schedule Adherence	59 seconds	4 minutes + 59 seconds
MARTA *Schedule Adherence	0 minutes + 30 seconds	5 minutes + 30 seconds
MTA New York City *Schedule Adherence	1 minute	5 minutes

This example demonstrates the importance of clearly documenting every aspect of each performance measure the agency selects. In the target-setting process (Component 02), the agency may decide to benchmark with peer agencies to create a context for the target being set. Knowing the details and definitions behind both internal and external measures ensures that benchmarking provides useful information to help set a proper target.

Minnesota Department of Transportation Performance Reporting

In an effort to evaluate service delivery and program effectiveness, MnDOT established a transportation performance management plan intended to ensure transparency, support decision-making and enhance management practices. To communicate performance to stakeholders, the organization created a transportation results scorecard documenting measures, targets, results, score, and trend figures, along with an analysis of results.

[44] Washington Metropolitan Area Transit Authority. (2008). Operational Performance. http://www.wmata.com/about_metro/board_of_directors/board_docs/100208_OPSPerformance.pdf

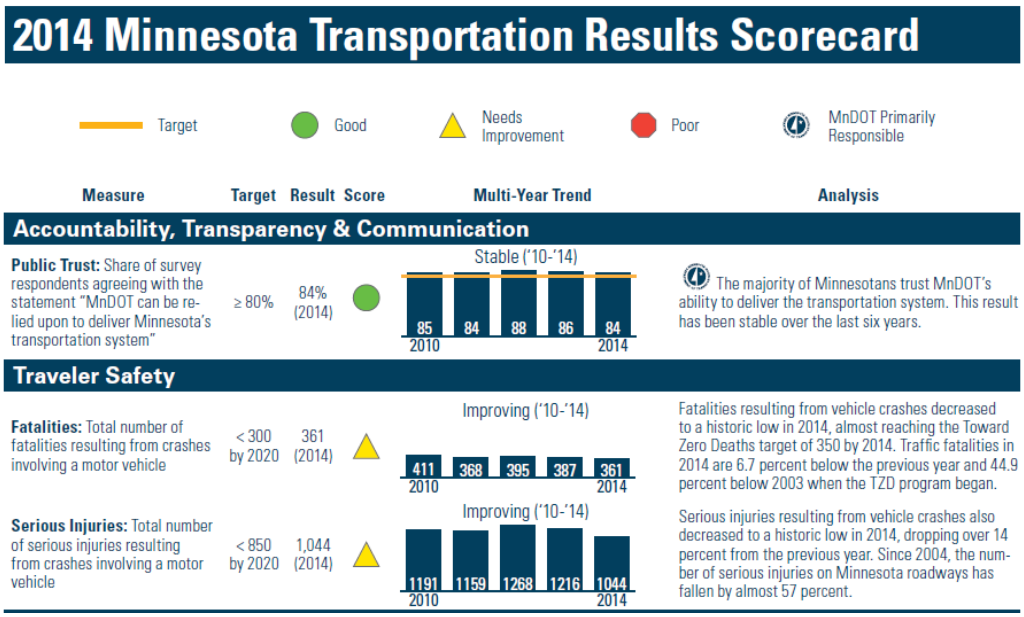
[45] Washington Metropolitan Area Transit Authority. (2011). Bus Performance Board Nov. 2010. Washington, DC.

STEP 1.2.5	Document the process and measure details

The components shown below illustrate how MnDOT documents and shares its data and delivers performance results.

Figure 1-16: Encouraging Transparency through Self-Reporting with MnDOT

Source: 2014 Minnesota Transportation Results Scorecard[46]



Linkages to Other TPM Components		
	Component A: Organization and Culture	(See TPM Framework)
	Component C: Data Management	
	Component 02: Target Setting	

[46] Minnesota Department of Transportation. (2014). 2014 Minnesota Transportation Results Scorecard. http://www.dot.state.mn.us/measures/pdf/2014scorecard.pdf

RESOURCES

Resource	Year	Link
TPM Toolbox	2016	www.tpmtools.org
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
FHWA Interim Guidance on National Performance Measure Development	2012	http://www.regulations.gov/#!documentDetail;D=FHWA-2013-0020-0016
A Guidebook for Performance-Based Transportation Planning (NCHRP Report 446)	2000	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf
Performance Measurement Framework for Highway Capacity Decision Making (SHRP 2 Report S2-CO2-RR)	2009	http://onlinepubs.trb.org/onlinepubs/shrp2/shrp2_S2-C02-RR.pdf
Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning	2012	http://www.fhwa.dot.gov/planning/performance_based_planning/mlrtp_guidebook/
Performance Measurement: Getting Results	2006	Book, Harry P. Hatry (author) https://books.google.com/books/about/Performance_Measurement.html?id=PQNUNlwdbDQC

ACTION PLAN

1. Of the TPM subcomponents discussed in this chapter, which would you like to work on?

❑ 1.1 Goals and Objectives ❑ 1.2 Performance Measures

2. What part of the TPM process listed above are you focusing on? What does your agency want to change or improve?

3. What "step(s)" discussed in this chapter do you think could help you address the focus area noted above?

Goals and Objectives

- ❑ Understand the performance context to create a vision
- ❑ Build inclusive internal process to develop goals and objectives
- ❑ Engage external stakeholders to refine goals and objectives
- ❑ Evaluate goals and objectives
- ❑ Document the process

Performance Measures

- ❑ Inventory data, tools, and performance reports
- ❑ Engage internal staff and external stakeholders
- ❑ Evaluate potential measures
- ❑ Establish governance process
- ❑ Document the process and measure details

4. To implement the "step(s)" identified above, what actions are necessary, who will lead the effort and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success?

6. Who is someone (internal and/or external) to collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

TABLE INDEX

U.S. Department of Transportation
Federal Highway Administration

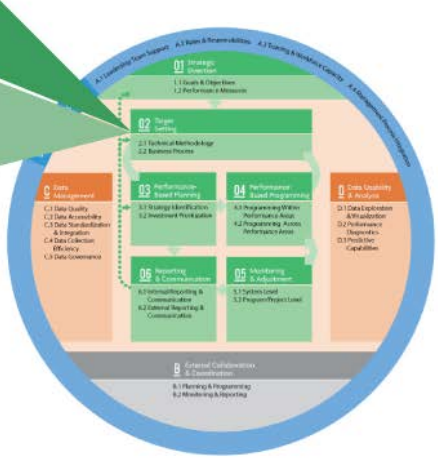
COMPONENT 02

TARGET SETTING

This chapter provides assistance to transportation agencies with the "Target Setting" component of Transportation Performance Management (TPM). It discusses where target setting occurs within the TPM Framework, describes how it interrelates with the other nine components, presents definitions for associated terminology, provides links to regulatory resources, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for target setting may differ from what is included in this chapter.

02 Target Setting

2.1 Technical Methodology
2.2 Business Process



Target Setting is the use of baseline data, information on possible strategies, resource constraints, and forecasting tools to collaboratively establish a quantifiable level of performance the agency wants to achieve within a specific time frame. Targets make the link between investment decisions and performance expectations transparent across all stakeholders.

INTRODUCTION

Target setting within the TPM Framework is an evidence-based and data-driven, collaborative process that establishes what an agency desires to achieve within a specific time frame. The target-setting process uses the goals, objectives, and performance measures of the Strategic Direction (Component 01) and determines the anticipated outcomes to be achieved. Targets are used to assess progress toward achieving strategic goals, guide planning efforts, inform programmatic decisions and adjustments, and communicate with the public and other stakeholders. Targets make the link between investment decisions and performance expectations transparent for all stakeholders. In short, the process of setting targets completes the foundation (along with the Strategic Direction, Component 01) from which strategic decision-making is launched.

The target-setting process is vital to the implementation of TPM and offers unique and powerful benefits to an agency by:

- Driving a conversation about current conditions and how to achieve future outcomes;
- Creating a method for evaluating processes currently in place, particularly data quality and measurement definitions used by the agency;
- Guiding the prioritization and allocation of resources;
- Enabling assessment of strategy effectiveness by focusing on linking goals, objectives, and measure to policy and investment decisions;
- Forming a powerful argument for additional or alternative investments; and
- Managing expectations by clarifying what outcomes are desired.

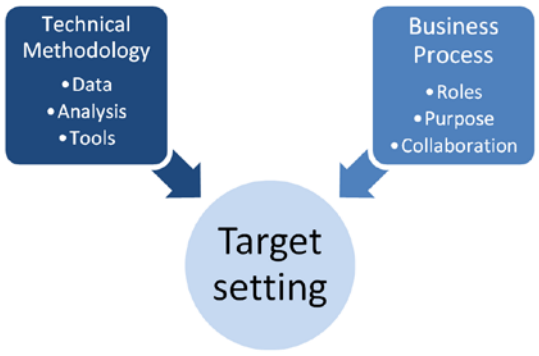
The target-setting process is intertwined with the tenets of TPM: connecting employee actions to results, motivating and focusing staff, increasing accountability, identifying opportunities for external collaboration, guiding the allocation of resources, and tracking the efficacy of various programs and strategies.

Evidence-based and data-driven target setting is founded on quality data, good analyses (i.e., technical methodology), and solid business processes.

- **Quality data** are the foundation to observing the baseline, conducting trend line analysis, and estimating forecasts. It is important to know the limits of the data: see Data Management (Component C) and Data Usability and Analysis (Component D). If quality data are not available, what are the strategies that can be applied to improve the usability of the data?
- **Good analyses** are the approaches used to convert data into valuable evidence-based and data-driven information, enabling target setting.
- Without **good business processes** in place and documented for accountability and repeatability, target setting will not be sustainable.

SUBCOMPONENTS AND IMPLEMENTATION STEPS

Figure 2-1: Subcomponents for Target Setting
Source: Federal Highway Administration



The definition for target setting is: The use of baseline data, information on possible strategies, resource constraints, and forecasting tools to collaboratively establish a quantifiable level of performance the agency wants to achieve within a specific time frame. Targets make the link between investment decisions and performance expectations transparent across all stakeholders. Target setting is broken down into two complementary subcomponents (Figure 2-1).

- **Technical Methodology:** Implementation of an evidence-based and data-driven approach for observing a baseline and evaluating a performance trend.
- **Business Process:** Establishment of an intra-agency process including internal coordination and collaboration to establish and modify performance targets.

The technical methodology relates to the compilation and analysis of historical, current, and projected performance data to guide target setting, while the business process builds internal collaboration, defines roles, and specifies the steps necessary to ensure a strong internal target setting approach is in place. Steps undertaken in the Business Process also determine how, when, and to what extent external collaboration is needed (see External Collaboration and Coordination, Component B). The technical methodology is how the "number" is established that becomes the target. This will involve observing and examining baseline trends, performance data, developing trend lines (i.e., historical and projected trends), and analyzing future scenarios. In addition to establishing a solid technical approach to target setting, agencies should establish and sustain an internal business process to gain agreement on a realistic target. This includes defining the agency's key players and establishing a process that ensures coordination in target setting across different performance areas, and leveraging external collaboration. Through regularly scheduled activities, a continuous cycle is created including target setting, Performance-Based Planning (Component 03), Performance-Based Programming (Component 04), and Monitoring and Adjustment (Component 05) to ensure objectives, goals, and measures (Strategic Direction, Component 01) are linked to policy and investment decisions.[1] Both subcomponents are necessary and implementation steps from each are completed concurrently, as the agency deems useful. Table 2-1 presents the implementation steps for target setting that will be further explored in this chapter.

Table 2-1: Target Setting Implementation Steps

Source: Federal Highway Administration

Technical Methodology	Business Process
1. Establish a baseline	1. Assign internal roles and responsibilities
2. Analyze historical trends	2. Clarify purpose of the target
3. Identify influencing factors and assess risk (internal and external)	3. Gather information through benchmarking
4. Define target parameters	4. Reflect external stakeholder interests
5. Forecast future performance	5. Document the business process
6. Document technical methodology	

Because target setting relies on a carefully investigated baseline, the development of future scenarios, and an understanding of future programming and resource allocation decisions, a transparent target-setting process creates an open dialogue about specific outcomes the agency wants to achieve and articulates the connection between actions and results. Initially, actions required to achieve established targets are clarified; later, during Monitoring and Adjustment (Component 05), the effects of past actions are re-examined to determine what changes should be made to realign agency strategies toward target attainment. Targets also provide justification necessary to make the case for additional resources and more or better quality

> "Target setting should not focus on a single target value for a performance measure, but on achieving improved performance over time. The value of performance management is found in better decision-making, not target achievement."
>
> Source: AASHTO SCOPM Task Force Findings on MAP-21 Performance Measure Target-Setting (March 2013)

[1] FHWA. (2013). *Safety Target Setting Final Report*. FHWA-SA-14-009. http://safety.fhwa.dot.gov/hsip/spm/docs/safetyfinalrpt.pdf

data. As transparent target setting percolates through an organization, the relationship between each employee's day-to-day activities and the desired results becomes more real, further imprinting TPM practices across the organization.

CLARIFYING TERMINOLOGY

Table 2-2 provides definitions for the target setting terms used in this Guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table 2-2: Target Setting: Defining Common TPM Terminology

Source: Federal Highway Administration

Common Terms	Definition	Example
Baseline	The observed level of performance for a specified performance period from which implementation begins, improvement is judged, or comparison is made.	2014 fatality rate = 0.83 per 100 million miles of travel.
Benchmarking	A comparison of two numbers, often historical data, with current numbers or one agency's results against its peer's.	Assessing an agency's fatality rate by comparing it to that of a peer agency, or to historic fatality rates.
Goal	A broad statement of a desired end condition or outcome; a unique piece of the agency's vision.	A safe transportation system.
Metric	An indicator of performance or condition.	The annual number of fatalities.
Objective	A specific, measurable statement that supports achievement of a goal.	Reduce the number of motor vehicle fatalities.
Performance Measure	Performances measures are based on a metric that is used to track progress toward goals, objectives, and achievement of established targets. They should be manageable, sustainable, and based on collaboration with partners. Measures provide an effective basis for evaluating strategies for performance improvement.	Transit passenger trips per revenue hour.
Performance Period	An established timeframe for monitoring results and collecting data and information for performance reporting.	A calendar year.
Target	Level of performance that is desired to be achieved within a specific time frame.	Two % reduction in the fatality rate in the next calendar year.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.

Common Terms	Definition	Example
Trend line	A trend distilled from historical or projected performance data.	The graph depicting annual fatality rate and five-year average fatality rate from 2000 to 2014.

RELATIONSHIP TO TPM COMPONENTS

The ten TPM components are interconnected and often interdependent. Table 2-3 summarizes how each component relates to the target setting component.

Table 2-3: Target Setting Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to Target Setting
01. Strategic Direction	The establishment of an agency's focus through well-defined goals and objectives and a set of aligned performance measures.	Targets turn goals/objectives and measures identified in the strategic direction into statements of desired outcomes.
03. Performance-Based Planning	Use of a strategic direction to drive development and documentation of agency strategies and priorities in the long-range transportation plan and other plans.	Targets describe the anticipated outcomes the strategies and priorities in these plans are striving to achieve.
04. Performance-Based Programming	Allocation of resources to projects to achieve strategic goals, objectives and performance targets. Clear linkages established between investments made and their expected performance outputs and outcomes.	Targets can influence and be influenced by the prioritization of the projects included in the STIP and TIP and agency budgets. Targets are needed to track progress toward expected performance outcomes.
05. Monitoring and Adjustment	Processes to monitor and assess actions taken and outcomes achieved. Establishes a feedback loop to adjust programming, planning, and benchmarking/target-setting decisions. Provides key insight into the efficacy of investments.	Targets provide the "stake in the ground" around which to evaluate the effectiveness of implemented strategies, progress toward goals, identification of unforeseen issues, and potential programmatic adjustments.
06. Reporting and Communication	Products, techniques, and processes to communicate performance information to different audiences for maximum impact.	Targets are integral to an agency's performance language and are used to illustrate progress made, challenges incurred, and next steps related to the strategic goals.
A. TPM Organization and Culture	Institutionalization of a TPM culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support TPM.	Targets clearly communicate to all employees what the agency is trying to achieve and where the agency should focus its efforts. For targets to be embraced they also need to reflect the agency's current culture.

Component	Summary Definition	Relationship to Target Setting
B. External Collaboration and Coordination	Established processes to engage and collaborate with agency partners and stakeholders on planning/visioning, target setting, programming, data sharing, and reporting.	The target setting process provides an ideal opportunity to collaborate with outside partners in order to establish targets, gain their support for agency's efforts, and find common areas of interest.
C. Data Management	Established processes to ensure data quality and accessibility, and to maximize efficiency of data acquisition and integration for TPM.	The availability of data and the quality of data provide the foundation of target setting.
D. Data Usability and Analysis	Existence of useful and valuable data sets and analysis capabilities, provided in usable, convenient forms to support TPM.	The usability of data to observe baselines, examine trends, and prepare forecasts plays a significant role in the target setting process.

REGULATORY RESOURCES

This Guidebook is intended to assist agencies with implementing transportation performance management in a general sense and not to provide guidance on compliance and fulfillment of Federal regulations. However, it is important to consider legislative requirements and regulations when using the Guidebook. In many cases, use of this Guidebook will bring an agency in alignment with Federal requirements; however, the following sources should be considered the authority on such requirements:

Federal Highway Administration

- Transportation Performance Management: http://www.fhwa.dot.gov/tpm/links_fhwa.cfm
- Fact Sheets on Fixing America's Surface Transportation (FAST) Act: https://www.fhwa.dot.gov/fastact/factsheets/
- Fact Sheets on Moving Ahead for Progress in the 21st Century (MAP-21): https://www.fhwa.dot.gov/map21/factsheets/
- Resources on MAP-21 Rulemaking: https://www.fhwa.dot.gov/tpm/rule.cfm

Federal Transit Administration

- Fact Sheets on FAST Act: https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-fast-act
- Resources on MAP-21: https://www.transit.dot.gov/regulations-and-guidance/legislation/map-21/map-21-program-fact-sheets

IMPLEMENTATION STEPS

2.1 TECHNICAL METHODOLOGY

The technical methodology will provide an agency with target options to consider. The following section outlines steps agencies can follow to implement a sustainable technical methodology to target setting.

1. Establish a baseline
2. Analyze historical trends
3. Identify influencing factors and assess risk (internal and external)
4. Define target parameters
5. Forecast future performance
6. Document technical methodology

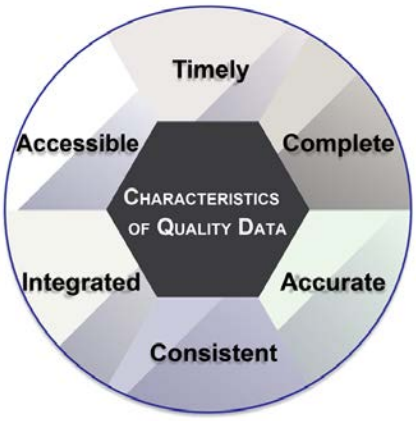
> "Target setting is difficult for many reasons, including limitations in data and tools to forecast expected performance levels, uncertainties due to exogenous factors that may affect performance, concerns about setting targets that are either too ambitious or too modest, and public and elected officials' perceptions, among other issues."
>
> Source: Target Setting Peer Exchange (2014)

STEP 2.1.1	Establish a baseline

Description

Figure 2-2: Characteristics of Quality Data

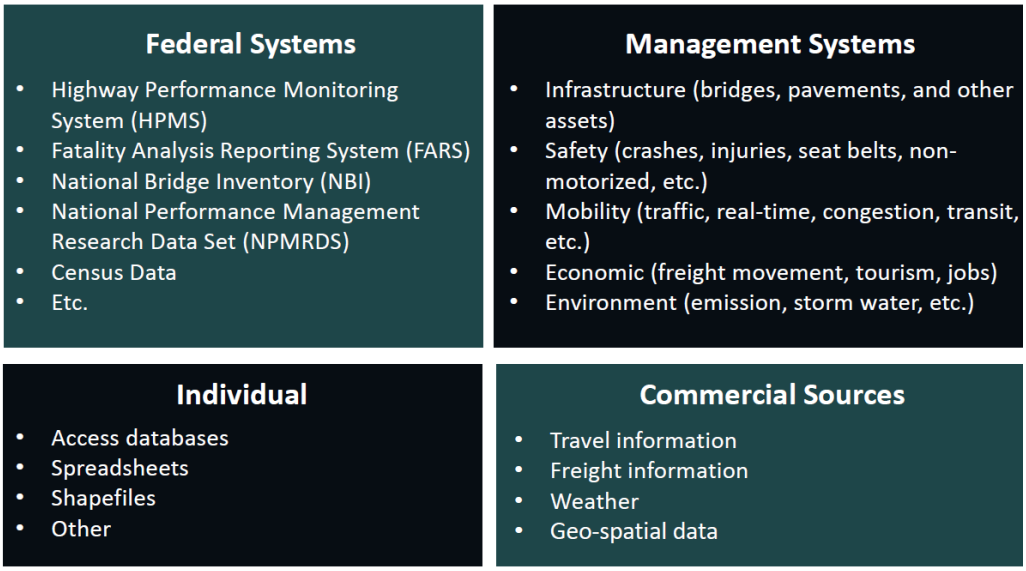
Source: Federal Highway Administration



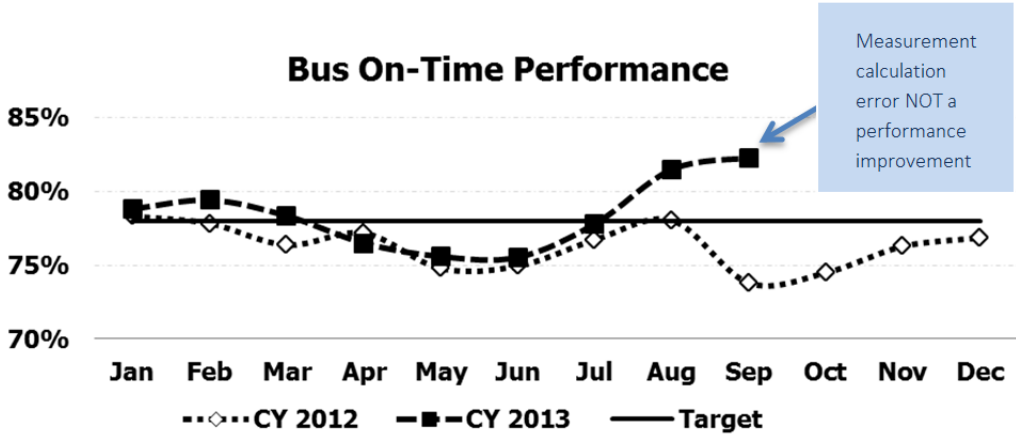
The most important first step in the target setting process is to assemble data to develop a baseline for the performance measures established in the Strategic Direction (Component 1). The baseline illustrates past performance, and serves as a jumping off point from which implementation and progress begins. Developing a baseline means digging into what data the agency has available and how it is organized. For new measures, agencies may be limited to a single baseline value for one point in time, which provides a starting point from which a trend line can be created. As this quote from the Safety Target Setting Final Report illustrates, a chosen performance measure may determine the approach for determining the baseline:

> The first consideration when setting a target is what will be used for a base-year value against which the target will be compared. According to *Traffic Safety Performance Measures for States and Federal Agencies*, a three- or five-year rolling average is recommended. Rolling averages show long-term trends more clearly than annual counts. The longer the time period for which the average is used, however, the longer it will take for trends to show up in the data. If a multiyear average is used, a State or region also will likely track annual numbers.[2]

[2] FHWA. (2013). *Safety Target Setting Final Report*, 42. FHWA-SA-14-009. http://safety.fhwa.dot.gov/hsip/spm/docs/safetyfinalrpt.pdf

STEP 2.1.1	Establish a baseline
	The baseline will also be critical to informing performance forecasts. Activities involved in establishing a baseline are: • Determine data source, ownership, and when updated • Assess data quality • Identify data gaps • Formulate strategies to close data gaps, if cost-effective • Use agreed-upon data to establish baseline
Examples	**Figure 2-3: Example Data Sources to Support Establishment of a Baseline** Source: Federal Highway Administration 
Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework) Component C: Data Management Component D: Data Usability and Analysis

STEP 2.1.2	Analyze historical trends
Description	This step involves examining and analyzing the trend data that has been assembled in order to try and understand reasons for observed variations. The purpose of this step is look to the past for clues as to where the agency is going. Understanding past results can provide direction for setting future targets; why did the agency get the observed performance results? **Specific activities include:** • Confirm that measure calculations are consistent and comparable over time • Identify repeating patterns and correlate them with other external trends (e.g., economic upturn and higher congestion) • Investigate atypical variations in trend (e.g., severe winter weather) • Locate "shifts" in the trend line due to policy changes (e.g., lifting of motorcycle helmet law)

STEP 2.1.2	Analyze historical trends
Examples	The importance of confirming that performance measure calculations are consistent and comparable over time was demonstrated at the Washington Metropolitan Area Transportation Authority (WMATA). In December 2013, WMATA reported to their Board of Directors that bus on-time performance had improved to over 80%, a historically un-chronicled level. Unfortunately, WMATA had to retract this statement when staff discovered that this result was due to new fleet technology failing to capture all the buses arriving early, thus compromising Bus On-Time Performance results for the latter portion of CY2013. **Figure 2-4: Bus On-Time Performance Calculation Error** Source: Adapted from WMATA Vital Signs Report[3] 
Linkages to Other TPM Components	Component C: Data Management (See TPM Framework) Component D: Data Usability and Analysis

STEP 2.1.3	Identify influencing factors and assess risk (internal and external)
Description	In order to understand past and future performance, it is essential to assess risk by identifying both internal and external influencing factors. Internal factors include issues within an organization that can potentially be addressed over time, since they are under the control of the agency, and in some cases may even be leveraged to ensure that the target is met. External factors, by contrast, are outside agency control, but still affect performance outcomes. The identification of internal and external factors is linked to the "analyze historical trends" step where the following question was asked, "why did performance change"? The answer to this question will undoubtedly uncover several factors that will continue to affect performance results. For example, the economy has a major influence on transportation performance. When the economy is strong, the roads are more congested, the pavements deteriorate due to greater truck traffic on highways, and freight flow increases. When population in a region increases, so do transportation demands. The recent oil boom in several states has resulted in changing traffic volumes and patterns in a manner that has been difficult to predict.

[3] Washington Metropolitan Area Transit Authority. (2013). Vital Signs Report: A Scorecard of Metro's Key Performance Indicators 2013 3rd Quarter Results. Washington, DC. https://www.wmata.com/about_metro/docs/Vital_Signs_Q3_2013.pdf

STEP 2.1.3	Identify influencing factors and assess risk (internal and external)

Figure 2-5: Identification of Factors Related to Performance Outcomes

Source: Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities.[4]

Both internal and external factors must be acknowledged in order to fully understand the context of the target, to anticipate any impacts on performance, and to begin addressing these issues as part of the TPM business approach.

In short, understanding influencing factors helps understand limitations. With a better understanding of the performance situation, targets can be more accurate and in turn more helpful. Table 2-4 contains a list of internal and external factors to consider in target setting.

Table 2-4: Internal and External Factors Impacting Performance

Source: Federal Highway Administration

Internal	External
Funding	Economy
Staffing constraints	Weather
Data availability and quality	Politics/legislative requirements
Leadership	Population growth
Capital project commitments	Demographic shifts
Planned operational activities	Vehicle characteristics
Cultural barriers	Zones of disadvantaged populations
Agency priorities	Modal shares
Agency jurisdiction	Gas prices
Senior management directives	Land use characteristics
Policy directives (e.g., zero fatalities)	Driver behavior
Cross performance area tradeoffs	Traffic
Collaboration across agency	

In addition to building a comprehensive list of all potential factors that might influence performance results and subsequently the target, agencies should also make an assessment of two items: 1) which factors will likely have the largest effect on performance results and 2) which factors the agency can influence or control. However, quantification (to the extent possible and practical) of the effect these factors have on results could be postponed until the "forecasting future performance" implementation step. As agencies complete additional

[4] Federal Highway Administration. (2012). Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities. http://www.fhwa.dot.gov/asset/pubs/hif12035.pdf

STEP 2.1.3	Identify influencing factors and assess risk (internal and external)

cycles of target setting, the ability to identify and understand the effect of various internal and external factors will increase.

Assessing the risk of internal and external influencing factors is a widely accepted method of understanding how such factors might influence a performance target and identifying approaches to mitigate their impact. Risk refers to the positive or negative effects of uncertainty or variability of any threat to achieving strategies, goals, and targets. Given that performance-based planning focuses on future outcomes, the inclusion of risk in the development of strategies and investment prioritization is important. Assessing and managing risk means determining the likelihood of such a threat occurring, as well as understanding and planning for the associated impacts. This is a key consideration in any planning effort, as part of those plans must address impacts that could cause them to derail. Risks may be positive or negative and generally can be defined as hazard, financial, operational, or strategic risks as summarized in Table 2-5.[5] Scenario planning can be an effective tool in assessing risk, among others. Risk is discussed at length in NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance (2015) and FHWA's Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities (2012).

Table 2-5: Summary of Key Definitions of Risk Types

Source: NCHRP 806[6]

Risk Type	Definition	Management
Hazard	The risk of uncertain performance due to condition and/or age of infrastructure or vulnerability to extreme events.	Addressed via contingency funding, specific strategies regarding improving condition, or reducing vulnerability to weather events. These may include prioritizing projects to achieve state of good repair (SGR), simulating deterioration probabilities, and constraining project list to the most critical.
Financial	The risk of a financial shift, such as a cut in revenues or a change in project cost.	Addressed via revenue source and trade-off understanding and simulation of various investment levels.
Operational	The risk that a prediction or strategy is incorrectly calibrated, leading to issues such as inaccurate forecasts or a lack of intended impact.	Addressed by a good feedback loop and review of forecasting abilities.

[5] Definitions summarized from *NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance,* 20. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

[6] Definitions summarized from *NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance,* 20. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

STEP 2.1.3	Identify influencing factors and assess risk (internal and external)

Strategic	The risk that management or specific programs have unforeseen weaknesses impacting the achievement of their intended purpose.	Addressed by understanding the sensitivity of performance preferences, targets, and resource allocation strategies. Strategy options may include silo versus integrated management, fixed versus flexible budget allocation, and worst first versus proactive preservation.

To guide the risk assessment and management piece of performance-based planning, consider the steps outlined as an International Organization for Standards standard (ISO 31000)[7] and used by the FHWA Risk-Based Transportation Asset Management guide. This can be a formal or informal process.

- **Establish the context:** Understand the social, legislative, economic, and environmental factors that may impact the agency or a particular goal, strategy, or target. This is analogous to the factor assessment that takes place for target setting.
- **Identify risk:** Determine which type of risk is possible out of the options above.
- **Analyze risk:** Understand the probability of the risk and its impact. This can be a basic understanding or rating, or it can be modeled for a more specific analysis.
- **Evaluate risk:** Understand the sensitivity of the agency the risk impacts; understand the severity of the impacts that the risk may cause.
- **Manage risk:** "Treat, tolerate, terminate, transfer, or take advantage of the risk."[8] In the context of performance-based planning, this means incorporating these steps into the planning process and developing strategies with an understanding of the risks, moving forward into the programming stage with flexibility to accommodate the kind of risks described above.

Items to keep in mind as an agency assesses and develops plans to mitigate risks associated with influencing factors include:

- Identifying potential internal and external influencing factors
- Categorizing factors by the extent of control an agency has over the results (e.g., "extensive," "moderate," or "limited" control)
- Assessing potential factors by the degree of on performance results
- Determining which factors should be considered in the current target setting effort
- Revisiting, periodically, the list of influencing factors to drop or add factors, or to change assessment of agency control and/or degree of influence

Examples

Degree of Influence over Risk Factors: Virginia Performs

The degree of influence an agency has over factors that affect performance outcomes will vary by factor. "Virginia Performs" is an on-line, publicly available tracker of the state's progress toward seven strategic goals. It includes an assessment of whether the state has "significant" or "limited" control of the results. For example, Virginia determined it has "limited" control over land use related factors such as population density and land development patterns. See more at http://vaperforms.virginia.gov/indicators/transportation/summary.php.

[7] ISO 31000 – Risk Management. http://www.iso.org/iso/home/standards/iso31000.htm

[8] New York State Department of Transportation. (2014). Transportation Asset Management Plan Draft v 05-02-14 (External Review). http://www.tamptemplate.org/wp-content/uploads/tamps/023_newyorkstatedot.pdf

STEP 2.1.3	Identify influencing factors and assess risk (internal and external)

Internal Factors Assessed for Risk: Escalator Availability

Escalator availability at a transit agency is at least partly within the agency's direct control. From the customer perspective, an out-of-service escalator is an inconvenience and negatively affects travel time and the overall experience of traveling by transit. Customers do not distinguish between an escalator being unavailable due to scheduled maintenance or due to an unforeseen issue (e.g., damage to handrail). Therefore, some transit agencies elect to include all escalator downtime in measuring the percentage of time units are available. In this case, when setting an escalator availability target, it is vital to include the hours necessary to conduct required inspections, preventive maintenance, and modernization activities that must be conducted during operating hours. Table 2-6 and the formula below (Equation 2-1) demonstrate that given required maintenance activities, the BEST availability is 95%:

Equation 2-1: Measuring Escalator Availability Performance

Source: Federal Highway Administration

100%	– 4%	– 1%	= 95%
Max availability	Scheduled replacements/ rehab	Other scheduled maintenance	BEST possible availability

Looking at past performance trends, some unscheduled maintenance will likely occur and should be reflected in the final availability target. Granted, efforts can be made to improve the speed and quality of both scheduled and unscheduled maintenance activities, but laying out the effect of planned capital activities in an easy to digest manner can greatly assist the target setting discussion.

Table 2-6: Impact of Scheduled and Unscheduled Maintenance on Escalator Availability

Source: Adapted from WMATA[9]

	Year 1 Data	Year 2 Data	Year 3 Estimate	Year 3 Actual - 6 months	Year 4 Estimate
Max Escalator Availability	100%	100%	100%	100%	100%
Less availability due to:					
Unscheduled Maintenance	10%	6.5%	5.6%	4.8%	5%
Scheduled Replacements and Rehabilitation	2.7%	3.2%	4.4%	2.9%	4%
Other Scheduled Maintenance	1.8%	1%	1%	0.6%	1%
Average Availability	85.5%	89.3%	89%	91.7%	90%
Target	89%	89%	89%	89%	90%

Linkages to Other TPM Components

Component 03: Performance-Based Planning (See TPM Framework)

Component B: External Collaboration and Coordination

Component C: Data Management

Component D: Data Usability and Analysis

[9] Created from WMATA escalator system availability data.

STEP 2.1.4	Define target parameters
Description	Targets can take on many different formats (e.g., percentage, directional, average value), different time horizons (e.g., daily to 10 year targets), and different scopes (e.g., regional, statewide, urban/rural). A key step in the technical methodology for target setting is determining these parameters. For example, in many cases, it may take a number of years for a significant investment to produce noticeable improvements in performance; annual targets may create a sense that progress is not occurring, or when it is occurring on a different time frame. In addition, the target parameters should reflect the purpose of the target (see subcomponent 2.2 Business Process). For example, agencies may elect to establish a set of targets with different time horizons to fill different needs (e.g., long-range to clarify desired policy objectives, mid-range to support management documents like Transportation Asset Management Plans, and short-range to guide annual budgetary decisions). **Items to keep in mind as target parameters are being evaluated:** • What will resonate with the target audience? • What parameters capture changes in performance results? • Consider the cost of data collection and presentation (e.g., more frequent may equate to more costly) • Reflect federal, state, and/or local reporting requirements (e.g., NHS bridges)
Examples	**Target Format:** How the change in performance is portrayed. Below is a list of the ways to communicate a target: • **Number**: The target is aiming for a specific number. *Example:* Achieve 300 or fewer crashes on state roadways this year. • **Directional**: The target is aiming for an increase or a decrease within a measure. *Example:* Reduce the number of crashes on state roadways annually. • **Percentage or Rate**: The target aims for a certain percent decrease or to impact a certain number of users. *Example:* Achieve a 20% decrease in number of crashes over the next 5 years. *Or:* Achieve a rate of 1 in 5 roadway users employing electronic tolling. • **Absolute**: The target can be "none" or "all." *Example:* Implement safety measures on all roadways. • **Tiered Targets**: Targets incorporating by their definition a range of outcomes, allowing flexibility in accommodating various expected risk of influencing factors. **Geography/scope:** Boundaries and filters applied to the area where performance is observed to set the extent of the target. Consider whether the scope is urban, rural, regional, corridor, one or several modes, NHS/non-NHS, etc. Keep in mind that this part of the scope is directly tied to the external factors discussed above, and that a wider geographic scope likely means more external factors to consider. The scope must resist overextending beyond the realm of responsibility. Federal regulations allow agencies to set their individual targets and determine whether to set separate targets for urban v. rural areas under an agency's jurisdiction. However, federal target format and horizon will be set via rulemaking.

STEP 2.1.4	Define target parameters

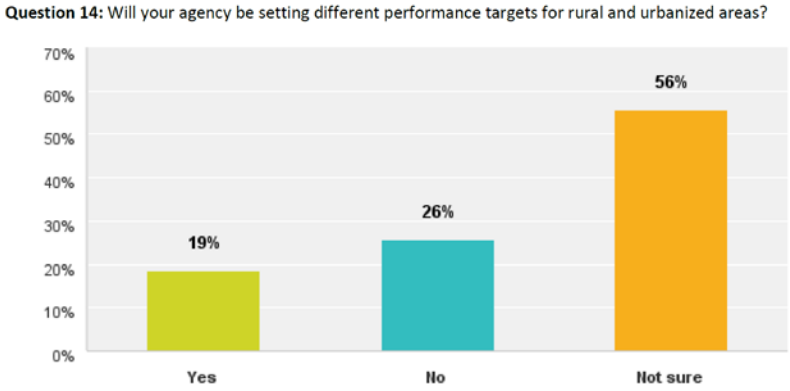
Some considerations include:

- Area of influence: Can the decisions you make impact the scope you set?
- Federal and State requirements may determine scope.
- What is the interest of external stakeholders?
- Does the definition of scope encourage friendly competition (e.g., across districts) or lead to incorrect conclusions?
- Can related scopes that you set be aggregated? (E.g., because interstate and non-interstate NHS subsets of the NHS, they cannot be aggregated)

Prior to a 2014 peer exchange, State DOTs were asked if they planned to set different performance targets for rural non-urbanized and urbanized areas – or for two different scopes. The majority of the respondents indicated that they were "not sure."[10] For the agencies that indicated they would set different targets, the reasons given included different acceptable thresholds for urbanized versus rural non-urbanized delay and different infrastructure condition needs by roadway type.

Figure 2-6: State DOT Stated Desire for Setting Urbanized and Non-Urbanized Targets

Source: Target Setting Peer Exchange: Summary Report[11]



Time Horizon: Duration of time that will be the basis for reaching the target. This parameter should be carefully considered and chosen as is appropriate to the type of target and the feasibility of attaining a specific outcome.

Table 2-7: Target Setting Horizons

Source: Federal Highway Administration

Type	Short Range	Mid-Range	Long Range
Years	Weekly, Monthly, Annual to < 5years	>5 years ; ≤ 10 years	>10
Usage	Business Plans	Asset Management Plans	Long Range Transportation Plans

[10] Federal Highway Administration. (2014). *Target Setting Peer Exchange: Summary Report*. Washington, DC. https://www.planning.dot.gov/Peer/Arizona/scottsdale_6-17-14_FHWA_target_setting.pdf

[11] Federal Highway Administration. (2014). *Target Setting Peer Exchange: Summary Report.* Washington, DC. https://www.planning.dot.gov/Peer/Arizona/scottsdale_6-17-14_FHWA_target_setting.pdf

STEP 2.1.4	Define target parameters
	Most useful for: Areas where agency has more direct control (e.g., asset condition) / Areas where change occurs very slowly or a long lag time between investments and results Note: the frequency of reporting performance results is different than the target time horizon. For example, an agency may have an annual target for bus on-time performance but the performance data are assessed daily.
Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework) Component C: Data Management Component D: Data Usability and Analysis

STEP 2.1.5	Forecast future performance
Description	The purpose of this step is to identify a range of potential performance target options that may lead to a particular performance outcome. These options also feed into the target setting business process (subcomponent 2.2), the Performance-Based Planning (Component 03), and Performance-Based Programming (Component 04) processes. Given that targets specify a desired level of future performance, it is preferable (though often challenging) to develop forecasts of future performance to understand what is feasible to achieve. As discussed in Step 2.1.3, forecasting future performance should attempt to account for both internal and external factors that will affect results. A range of tools, models and methods are available to predict future performance. "Agencies will need to calculate a baseline of performance and forecast expected performance based on that baseline in order to set targets. For many agencies, this will require an understanding of tools that do not currently exist." Source: AASHTO SCOPM Target Setting Peer Exchange (2014) **Activities for development of forecasts include:** • Document assumptions • List what factors are considered in forecasts • Develop future scenarios based on different funding levels
Examples	Below are examples of analytical tools and methods that agencies have used to forecast and communicate performance results, which can then be used to support the identification of specific targets.[12] **Bridge** • Bridge Management software (BrM), formerly Pontis • Deterioration models to predict future bridge condition based on past data and bridge age • Algorithms to process National Bridge Inventory (NBI) and Element data to establish

[12] AASHTO SCOPM MAP-21 Target-Setting Workshop held in June 2013

STEP 2.1.5	Forecast future performance

targets

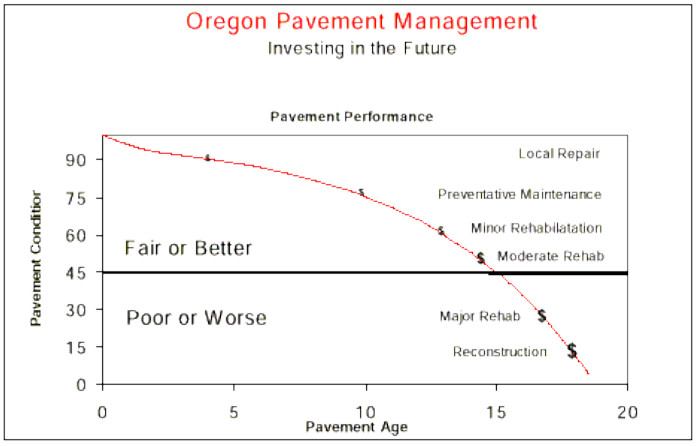
- Forecasting tool that combines historic performance and historical funding level then predicts expected condition using expected funding target for the bridge program
- Full life cycle (75 year) analysis of bridge condition combined with revenue projections and construction inflations used to maximize the investment's impact on bridge assets
- A deficit report based upon current investment and condition compared with future investment

Pavement

- Pavement Management System (PMS): model future pavement conditions on a set of criteria such as traffic levels, asset type, age of pavement, and resource constraints
- GIS for data analysis and visualization
- Business Intelligence and visualization tools
- The graph in Figure 2-7 below predicts pavement performance as it ages, indicating how costs will increase if maintenance is deferred

Figure 2-7: Pavement Performance Related to Age and Investment Practices

Source: 2012 Pavement Condition Report[13]



Safety

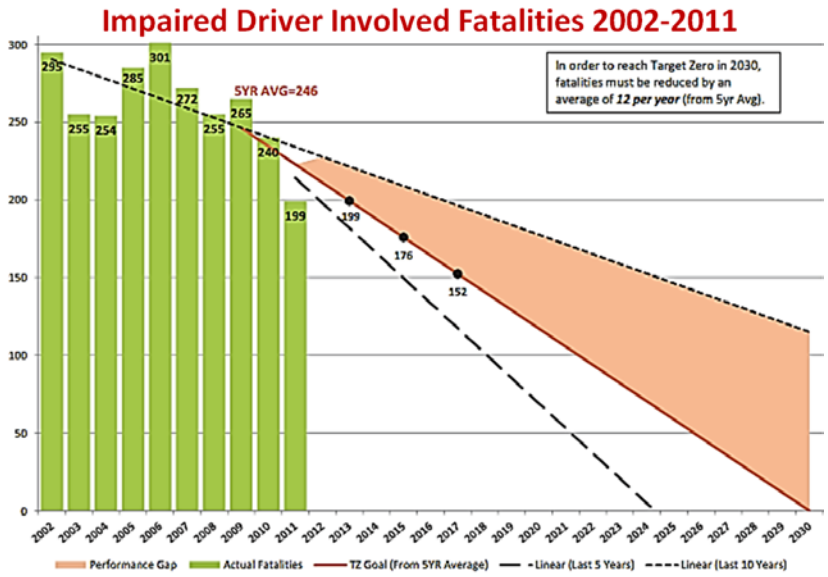
- Linear regression, rolling averages, best-fit regression analysis, non-linear regression, time-series analysis
- An example of a safety trend line is provided below Figure 2-8, which shows that a reduction of 12 fatalities per year would be required in order to achieve the target within the specified time frame. The pink area inside the "tail" shows the range of values that might be achieved. This type of display is helpful for visualizing changes in performance over time. The trend line uses both five- and 10-year rolling averages and targets are projected from the five-year rolling average baseline.

[13] Oregon Department of Transportation. (2012). 2012 Pavement Condition Report. https://www.oregon.gov/ODOT/HWY/CONSTRUCTION/docs/pavement/2012_condition_report.pdf

STEP 2.1.5	Forecast future performance

Figure 2-8: WSDOT Fatality Forecasting through 2030

Source: Washington State Strategic Highway Safety Plan 2013: Priority Level One, Impaired Driver Involved[14]



System Performance

- Travel demand models
- Highway Capacity Manual
- System transportation performance management systems
- Model estimating the economic benefits infrastructure improvements (e.g., Highway Economic Requirement System (HERS), Transportation Economic Development Impact System (TREDIS))
- National Emissions Inventory (NEI), Air Quality System (AQS) and Mobile 6.2

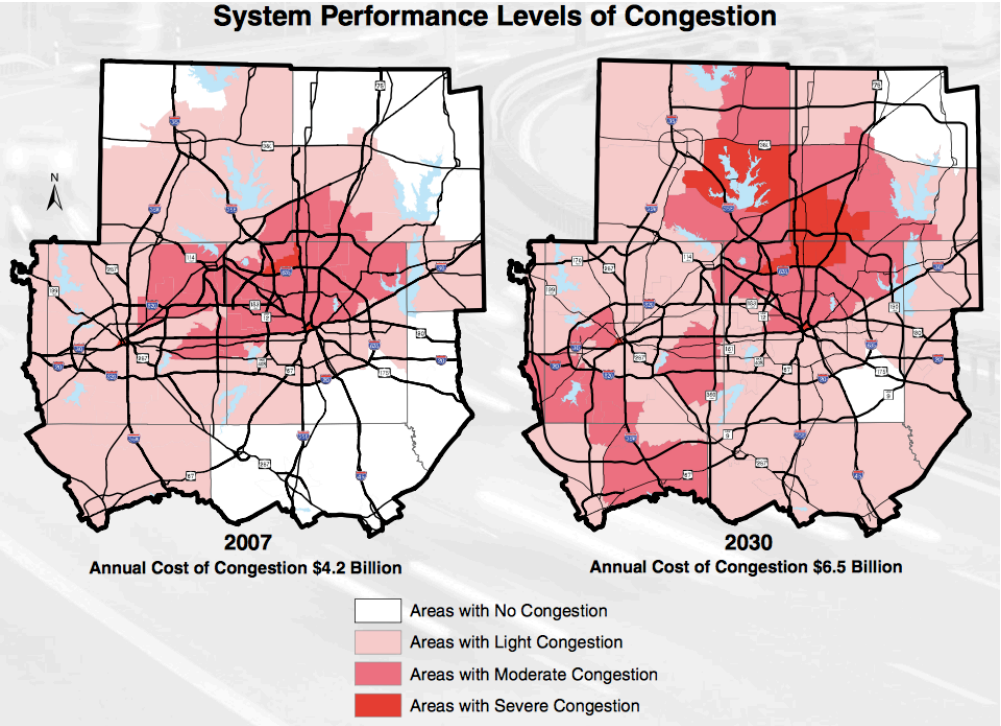
Figure 2-9 below depicts the future levels of congestion the North Central Texas Council of Governments (NCTCOG), the MPO for the Dallas Fort Worth area, forecasted using its travel demand model. It is important to note that the predicted rise in congestion is based on the assumption that all the strategies outlined in their Mobility 2030: The Metropolitan Transportation Plan were implemented. This type of analysis result–that congestion will continue to increase despite implementation of an extensive set of projects, programs and policies–is critical for target setting and establishment of public expectations.

[14] Washington State Department of Transportation. (2013). Washington State Strategic Highway Safety Plan 2013: Priority Level One, Impaired Driver Involved. http://www.wsdot.wa.gov/partners/targetzero/PDF2/priorityone.pdf

STEP 2.1.5	Forecast future performance

Figure 2-9: NCTCOG Projected Congestion by 2030

Source: M2030 2009 Amendment[15]



Funding Scenarios: Rhode Island DOT and Maryland State Highway Administration

Funding levels are a fundamental level for impacting performance results – and therefore analysis of funding scenarios is a common – and very helpful approach for target setting. The example below (Figure 2-10) shows bridge condition results for the Rhode Island Department of Transportation (RiDOT) based on different funding levels. The trend lines show that future performance results from the baseline are actually moving further away from the target performance. Portraying several different data lines on this chart shows the relationship between annual investment level and performance. This type of representation can be used to understand and communicate what funding levels would be required to achieve a given target. In Maryland, the ability to meet targets for structurally deficient bridges is directly linked to available funding (Figure 2-11).

[15] North Central Texas Council of Governments. M2030 2009 Amendment: The Metropolitan Transportation Plan, The Transportation Plan for the Dallas-Fort Worth Area, 2009 Amendment. Executive Summary. http://www.nctcog.org/trans/mtp/2030/Mob2030_09Amend_ExecSum.pdf

STEP 2.1.5	Forecast future performance

Figure 2-10: RIDOT Bridge Performance Forecast

Source: Federal Highway Administration

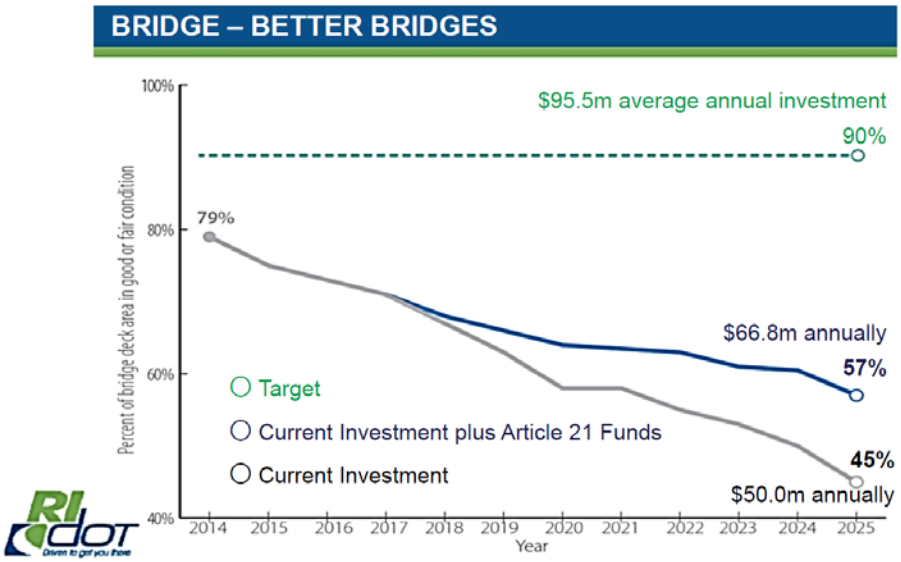
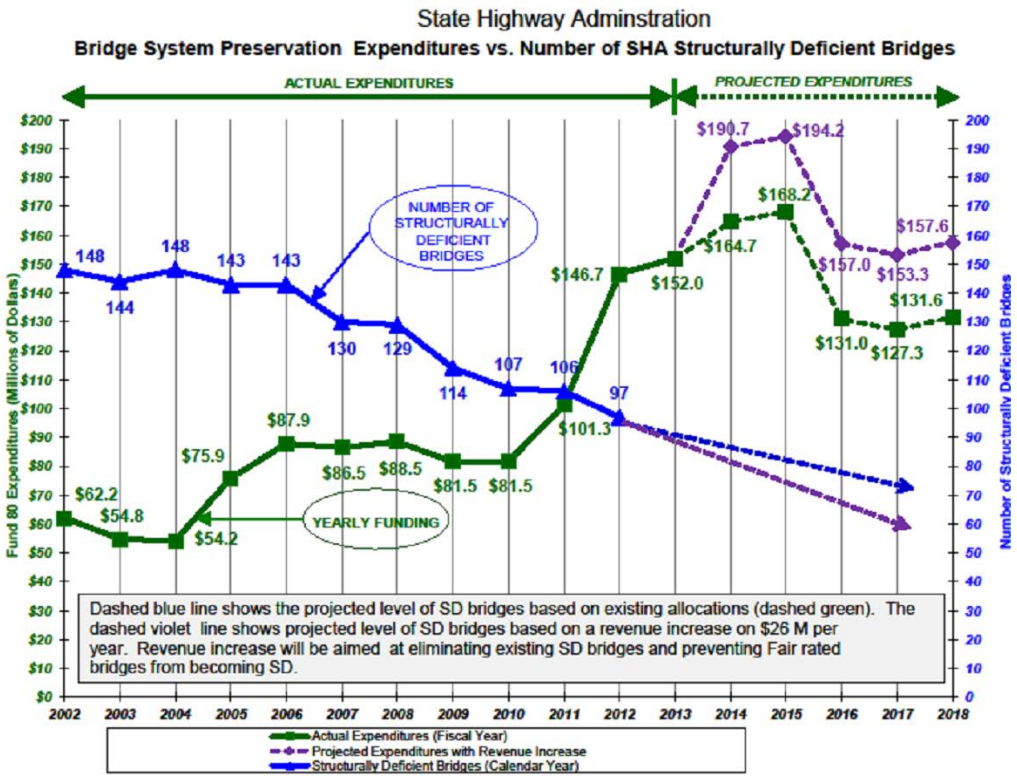


Figure 2-11: Maryland State Highway Administration Bridge Investment vs. Performance

Source: State of the State of Maryland's Bridges [16]



[16] Maryland State Highway Administration. (2014). State of the State of Maryland's Bridges. Hanover, MD.

STEP 2.1.5	Forecast future performance
Linkages to Other TPM Components	Component 03: Performance-Based Planning (See TPM Framework) Component 04: Performance-Based Programming Component C: Data Management Component D: Data Usability and Analysis

STEP 2.1.6	Document technical methodology
Description	The data-driven methodology for setting targets has been developed and now must be documented. The completion of this step means that an agency setting a target has a good understanding of their current status regarding data availability and capabilities, risk assessment, and tools to forecast results. This will be a rulebook and record of how the target methodology was conducted and why this approach was used. Documentation may not sound like the most exciting aspect of target setting, but it ensures the technical methodology is replicable from cycle to cycle, can withstand staff turnover, and establishes an air of transparency around target setting. Material from this document can also be used to communicate with internal staff and external stakeholders about the agency's target-setting technical methodology. As an agency goes through multiple cycles of target setting, update the documentation. For example, agencies may enhance their abilities to identify and understand the effect external factors have on performance results. Similarly, as various strategies are applied to improve performance, a better understanding of the linkage between actions and results can lead to improved target setting. Target setting, like many TPM components, is an iterative process, so it will be critical to document steps that were taken and subsequent adjustments made to an agency's technical methodology. **Topics to address in the technical methodology documentation include:** • Roles and responsibilities of involved staff • Business process milestones and schedule • Process flow map • Recommended adjustments for future target setting cycles • Specific issues related to each implementation step (see Table 2-8)

Table 2-8: Topics to Address in Technical Methodology Documentation

Source: Federal Highway Administration

Technical Methodology Step	Topics to Document
Establish a baseline	• Data source and owner • Data gaps • Date of last collection/update
Analyze historical trends	• Measure calculations and any changes over time • Explain "why performance changed"

STEP 2.1.6	Document technical methodology	
	Identify influencing factors and assess risk (internal and external)	• Define influencing factors • Categorize agency influence • Identify factors to include in next cycle and why
	Define target parameters	• Target format, geography/scope, and time horizon
	Forecast future performance	• Assumptions • Tools and methods used • Define scenario parameters and conclusions obtained

Examples

Documentation of Technical Methodology: PennDOT

As part of the Pennsylvania Department of Transportation's (PennDOT's) transportation performance management approach, the agency developed a set of "Production User Manuals" to document the definition, data source, calculations, reporting cycle, and purpose for each key performance measure (see

Figure 2-12 and Figure 2-13, below). These documents also describe how staff can use the Highway Administration Performance Dashboard (HAPD) to access raw data, view results, generate reports, and enter comments. Internal staff and external stakeholders responded positively to this transparent documentation of the data and technical methodology behind the targets posted on the HAPD scorecard.

> "The Production User Manuals pulled back the curtain to the technical methodology behind our performance scorecard providing improved clarity and transparency to previously often assumed and frequently misunderstood processes. As a result, people's trust in the data and published results improved because everyone knew where the numbers came from and how they were calculated."
>
> - Jim Ritzman, PennDOT

STEP 2.1.6	Document technical methodology

Figure 2-12: Highway Administration Performance Dashboard

Source: Adapted from Highway Occupancy Permit (HOP) Application Review[17]

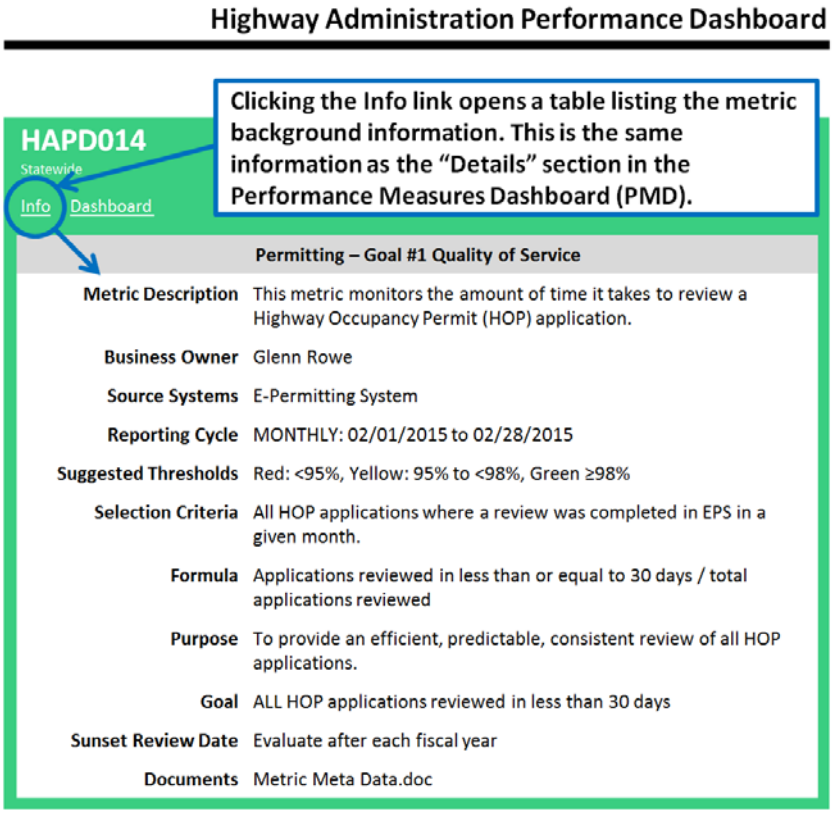


Figure 2-13: Expanded View for Specific Metric

Source: Highway Occupancy Permit (HOP) Application Review[18]

Info Tab Expanded View

***(Program Area)* Permitting | *(Strategic Focus Area)* Goal #1 Quality Service**	
Metric Description:	This metric monitors the amount of time it takes to review a Highway Occupancy Permit application.
Business Owner:	Glenn Rowe
Source Systems:	E-Permitting System
Reporting Cycle:	MONTHLY: 02/01/2015 To 02/28/2015
Suggested Thresholds:	Red: < 95% Yellow: 95% to < 98% Green: ≥ 98%
Selection Criteria:	All HOP applications where a review was completed in EPS in a given month.
Formula:	Applications reviewed in less than or equal to 30 days / total applications reviewed.
Purpose:	To provide an efficient, predictable, consistent review of all Highway Occupancy Permit (HOP) applications.
Goal:	All HOP Applications reviewed in less than 30 days.

[17] Pennsylvania Department of Transportation. (2015). Highway Occupancy Permit (HOP) Application Review Time-M. Harrisburg, PA.
[18] Pennsylvania Department of Transportation. (2015). Highway Occupancy Permit (HOP) Application Review Time-M. Harrisburg, PA.

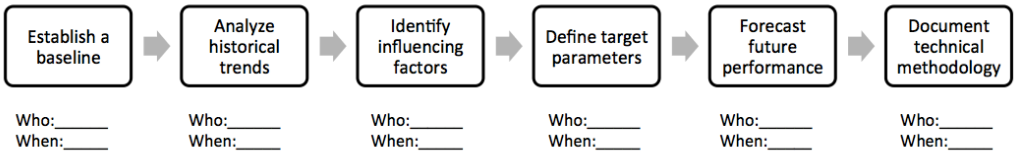
STEP 2.1.6	Document technical methodology

Process Flow Mapping: Example

A process flow map is a useful way to illustrate how the steps of a process are interrelated. The simple act of mapping out an agency's target-setting process can improve the understanding of the process, roles and schedule. There are many approaches to creating a process flow map, but some rules of thumb are to highlight the distinct steps taken, the flow of the steps, and any linkages between the steps. Figure 2-14 below illustrates a starting point for a process flow map for setting targets.

Figure 2-14: Process Planning with a Flow Map

Source: Federal Highway Administration



Linkages to Other TPM Components

Component 06: Reporting and Communication (See TPM Framework)

Component A: Organization and Culture

Component C: Data Management

2.2 BUSINESS PROCESS

On the process side, staff and stakeholders need to be informed and organized so that they align positively to finalize the selection of targets. The target options identified through the technical methodology should flow into a target setting business process. The business process answers the "who" and the "how" targets will be set. The following section outlines steps agencies can follow to implement a sustainable business process to target setting.

1. Assign internal roles and responsibilities
2. Clarify purpose of the target
3. Gather information through benchmarking
4. Reflect external stakeholder interests
5. Document the business process

> "Montana DOT has adopted a formal process for developing targets. Over time, the state legislature has gained confidence in the process and related funding requests because it provides consistent, quantifiable performance information that is fiscally constrained. The process is well received by the districts because it sets the type of work needed to meet the targets, but provides flexibility in terms of actual project selection."
>
> Source: NCHRP 551 Performance Measures and Targets for Transportation Asset Management

STEP 2.2.1	Assign internal roles and responsibilities
Description	A key first step in the target setting process is the identification of who will be involved in picking the final target and what role each person will fulfill. This would answer questions related to who at each agency level is responsible for setting targets as well has how to keep all affected offices engaged. Without clarity about who is accountable for what throughout the process, or who has decision-making control, the business process will likely be ineffective. **Key roles to determine, include:** • **Process leadership:** Who will lead, coordinate, and marshal the target-setting business process? If target setting is new to an agency, it will be important to identify a strong process facilitator. • **Input providers:** Practitioners invited to the table for the duration of the process will drive the conversation by making recommendations and suggestions to decision makers. Can include external stakeholders, but are predominately internal agency staff. • **Feedback contributors:** Group of individuals whose opinion and signoff is helpful, but who, for sake of expediency and organization, do not need to be at the table as part of the input group. • **Data trackers:** The tracking group may be made up of individuals also serving within capacities on the list above; this group is responsible for collecting and analyzing data used to establish and monitor performance targets. • **Decision makers:** These may vary at different stages of the process, but it should be clear who has the final decision on what the final target will be. All staff in these roles needs to understand how the baseline and target have been calculated, how they will be used, and how they will be communicated internally. They also need to understand who is in charge of decision-making and accountability, to ensure a clear chain of command and eliminate confusion and dead-ends.

STEP 2.2.1	Assign internal roles and responsibilities

Items to keep in mind as a baseline is developed:

- Identify a champion to lead the business process
- Use input from technical methodology as the business process foundation (e.g., baseline, historical analysis, forecasts)
- Ensure participants need to represent interest across agency silos (including staff who express resistance to target setting)
- Link to existing processes as much as possible (e.g., LRTP, budget development)
- Conduct an open dialogue about how targets will be used internally
- Clearly identify how targets will be finalized, including formal adoption procedures and incorporation of final targets into performance plans and processes

Examples

Internal Roles

> "New initiatives need good leaders."
>
> Source: NCHRP 8-92 Implementing Transportation Data Program Self-Assessment

Internally, roles and responsibilities of key players need to be defined and coordination of needs across performance areas must be established. This entails acknowledging that target choices in one performance area may affect performance in another area. For example, lowering pavement condition targets could have an impact on safety performance, or increasing mobility targets (increasing average speed for example) could impact safety. While the chance of success is reduced if one or more key people are missing at the table, bear in mind that there is a tradeoff to inviting too many voices to the conversation. A greater number of persons will make the target setting process longer and the business process more cumbersome. A rule of thumb is that when the number of persons doubles, the amount of time required will be squared (2*P=t^2). Rather than issuing a blanket invitation to all staff, consider their individual roles at the very beginning of the process, including the key decision of who is involved/invited to engage vs. who is informed after the fact.

WHO ARE THE INTERNAL KEY PLAYERS?

They could include:

- Agency leader (Secretary, CEO, Chief Engineer)
- Senior management
- Planning group
- Program managers
- Finance group managers/budget staff
- Performance measure drivers
- Data owners
- Technical analysts

Each of these has a role in data gathering, resource allocation or funding, and/or project selection. The group may change depending on how these tasks are assigned in your organization, and may change as the target setting process is refined. In addition, the level of involvement of staff will vary (e.g., agency leader may only be involved in the final target approval while performance measure drivers would be involved throughout the process).

STEP 2.2.1	Assign internal roles and responsibilities

The word cloud below (Figure 2-15) is a visual representation of State DOT responses to a survey distributed prior to the AASHTO Standing Committee on Performance Management (SCOPM) MAP-21 Target-Setting Workshop held in June 2013.[19] The specific question asked was, "Who within your agency would participate in the target-setting process for bridge condition, pavement condition, safety, freight, system performance and CMAQ Program"? Besides the observation that the range of practitioners involved in the target-setting process is wide, there appears to be the need to bring together the system performance area experts and planning staff.

Figure 2-15: Target Setting Stakeholders at a Glance

Source: AASHTO[20]

Once internal staff have been identified and the "involve vs. inform" roles clarified, it should be made clear to all stakeholders how the technical methodology (subcomponent 2.2) produced potential targets for consideration. Only if all involved are using the same set of assumptions and the same set of constraints and factors can a solid process occur.

Transportation performance management goes beyond the typical amount of coordination and collaboration of transportation planning, requiring different practice areas to consider how targets in each area relate to each other, what tradeoffs there may be, and how to support multiple goals simultaneously.[21] As a result, the group involved in the target-setting business process should pull from many areas of the organization.

Linkages to Other TPM Components	Component A: Organization and Culture Component B: External Collaboration and Coordination	(See TPM Framework)

[19] AASHTO SCOPM MAP-21 Target Setting Workshop, June 2013.

[20] American Association of Highway and Transportation Officials. (2013). Word Cloud from Target Setting Workshop, June 2013. Washington, DC.

[21] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

STEP 2.2.1	Assign internal roles and responsibilities
	Component 03: Performance-Based Planning Component 04: Performance-Based Programming Component 06: Reporting and Communication

STEP 2.2.2	Clarify purpose of the target

Description

Targets can take on many different roles within an agency from motivating staff to managing external expectations. A key step in the target setting business process is obtaining an agreed-upon and well-understood purpose for the target by answering two questions: (1) Who is the intended end user or audience for the target and (2) to what degree is the target evidence- or investment-based?

(1) **Target Audience:** Who is the end user or audience of the target? Focusing a target depending on different end users can reflect different purposes, some of which can overlap.

Table 2-9: Target Audience and Purpose

Source: Federal Highway Administration

Audience	Potential Purpose
Internal Staff	Motivate to improve results
Partners	Manage expectation and communicate investment needs
Leadership (i.e., Governor)	Drive focus on a specific strategic goal
Customers	Explain agency decisions
Regulatory	Meet legislative requirements

(2) **Evidence- or Investment-Based Target:** Ideally, targets are bound to a performance period; narrow; and focused specifically on what can be achieved within the context of a set of investments, policies, and strategies defined within an implementation plan. When initially establishing targets, an agency may need a few cycles to develop its capabilities to forecast future trends. Therefore, as an agency is building its forecasting capabilities, the agency may decide to set less aggressive evidence- or investment-based targets to build confidence in the agency's forecast trends.[22]
Example: Reduction of fatalities and injuries by two % for the next calendar year

Together the target audience and the aggressiveness of the target define the purpose for the target. For example, if an agency has recently experienced lower performance results and did not meet its targets, it would be counterproductive and even demoralizing to staff to set an unattainable target.

A target can be viewed as a promise to the public – so, set them with caution

[22] Federal Highway Administration. (2013). Safety Target Setting Final Report.

STEP 2.2.2	Clarify purpose of the target

Instead, the agency may consider a less aggressive target to boost agency staff confidence. In this situation, a less aggressive target may also help build trust with external stakeholders that the agency can deliver on a "promise." While targets may be less aggressive, they must remain evidence- or investment-based and clearly linked to relevant performance measures, objectives, and goals. The purpose of the target should also be reflected in the target parameters defined under subcomponent 2.1 Technical Methodology.

Items to keep in mind as the purpose of each target is being determined:

- Who is the target audience?
- What legislative mandates exist?
- How will results be communicated if target is or is not attained?
- To what degree is the target evidence- or investment-based?
- How aggressive is the target?

Examples

Setting Aggressive, Evidence-Based Targets

The team that manages Minnesota's Toward Zero Deaths (TZD) initiative worked with its partners to establish an aggressive target of 300 or fewer traffic fatalities and 850 serious injuries by 2020.

This aggressive number was established through the continued implementation of their Strategic Highway Safety Plan (SHSP), examining data from previous years, determining a trend line, and eventually setting a target number that helps Minnesota DOT and its partners communicate the need to invest in various strategies to address issues concerning:

- Traffic safety culture and awareness
- Intersections
- Lane departures
- Unbelted occupants
- Impaired roadway users
- Inattentive drivers
- Speed[23]

The purpose of this aggressive target also allows the Minnesota TZD team and its partners to better explain to customers how investment decisions connect to progress.

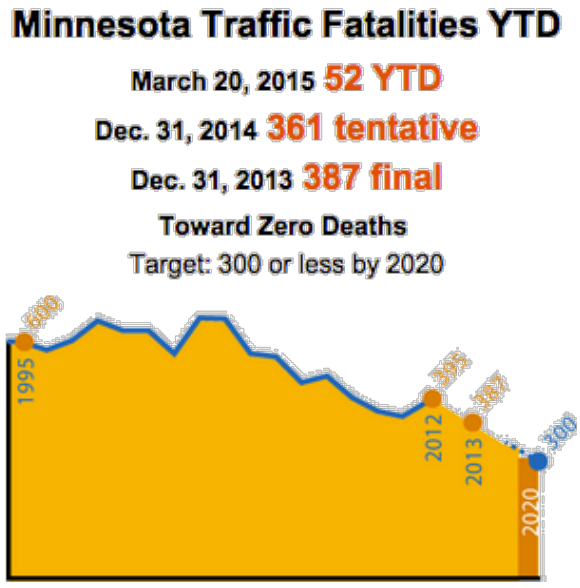


Figure 2-16: Performance Targeting
Source: Minnesota Department of Transportation[24]

[23] http://www.minnesotatzd.org/whatistzd/mntzd/mission/

[24] Minnesota Department of Transportation. (2015). St. Paul, MN. http://www.dot.state.mn.us/trafficeng/safety/

STEP 2.2.2	Clarify purpose of the target
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework) Component B: External Collaboration and Coordination Component 06: Reporting and Communication

STEP 2.2.3	Gather information through benchmarking
Description	Simply stated, benchmarking is a method to improve performance results by looking at (a) one's own historical patterns, (b) peer agency results, or (c) "best in class" practices. In the realm of target setting, all three types of benchmarking can provide valuable insights to the final selection of a target value. The "comparing against yourself" approach, or analyzing historical trends, was covered under the previous section (subcomponent 2.1 Technical Methodology). Gathering target information from peer agencies can clarify regional and national trends in specific performance areas, create a context for a target, and help explain a proposed target's value to external stakeholders. However, to properly bring external target values into an internal agency's target-setting process requires accurately identifying peer agencies (or clearly explaining the differences), confirming that similar data sources were used and ensuring consistent measure definitions were applied. **Items to keep in mind as agencies gather benchmarking information for use in target setting:** • Identify peer agencies based on similar attributes (e.g., infrastructure size, population, weather, topography, economy)[25] • Beware of benchmarking information being used to incorrectly compare agencies • Think through how the benchmark information will be used because the results may not fit the need
Examples	**Benchmarking with Peer Agencies** In 2004, several state DOT CEOs requested a multi-year research effort to look into the feasibility of sharing performance measurement results across agencies. As a result, ten NCHRP projects were developed (NCHRP 20-27 (37) Reports A-L)[26] that created peer groupings, compiled detailed performance data, and calculated commonly-defined measures. The research series demonstrated that sharing information between agencies can provide useful insights into target setting. Pavement condition is a good example of this as seen in Figure 2-17 below, which illustrates how pavement condition has similar patterns in each of the four regions. A bar represents the percent of pavement condition in good/fair/poor condition for the participating state by region. The similar results by region suggest some

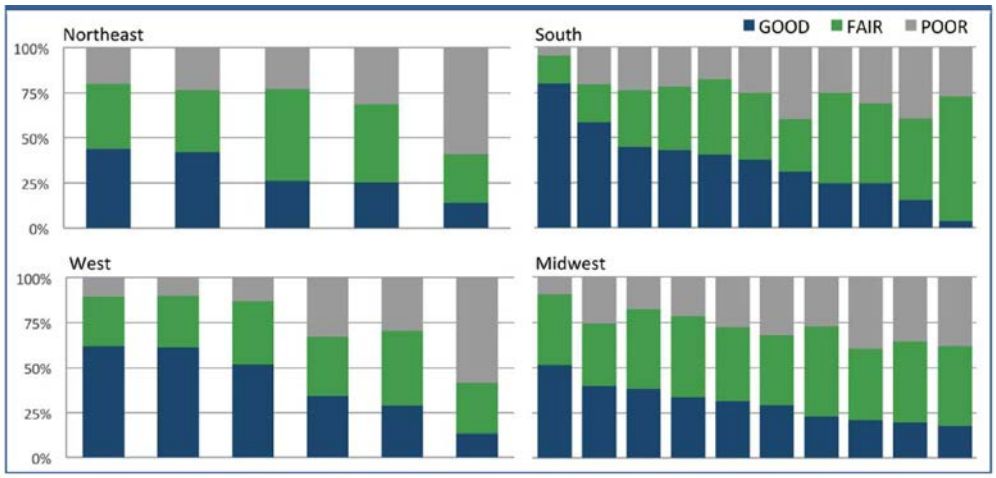
[25] American Association of State Highway and Transportation Officials. (2006). *Measuring Performance Among State DOTs*.
Identifying Peer States for Transportation System Evaluation and Policy Analysis. Transportation
July 2008, Volume 35, Issue 4, pp 445-465.
A Methodology for Performance Measurement and Peer Comparison in the Public Transportation Industry. (2010). TCRP Report 141.
[26] http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=543

STEP 2.2.3	Gather information through benchmarking

factors exist (e.g., weather conditions) that affect performance results. Therefore, when looking to gather peer information for target setting, agencies should reach out to peers in their geographic areas.

Figure 2-17: Interstate Pavement Condition (2006 and 2007)

Source: State DOT Comparative Performance Measurement: A Progress Report. AASHTO, 2012[27]



Benchmarking with "Best in Class": Missouri DOT

The Missouri DOT (MoDOT) considers customer satisfaction one of the agency's key performance indicators. On a regular basis, the agency conducts a survey where calls are made to approximately 3,500 randomly selected Missourians to gather feedback. These telephone survey results are presented in MoDOT's performance report, Tracker. [28] MoDOT is unique because the agency includes customer satisfaction results from "best in class" private industries compiled by the American Customer Satisfaction Index (Figure 2-18).

> "Comparing MoDOT's customer satisfaction results against well-known private sector companies sends the message to our customers that our goal is to provide "outstanding customer service."
>
> - Karen Miller, MoDOT

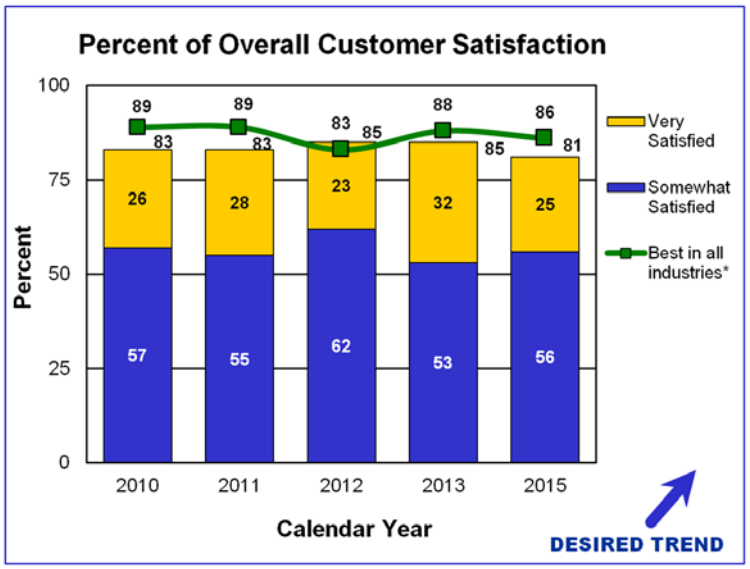
[27] American Association of Highway and Transportation Officials. (2012). State DOT Comparative Performance Measurement: A Progress Report. Washington, DC. http://maintenance.transportation.org/Documents/Progress%20Report%20Final%20Draft-5-10-2012.pdf

[28] http://www.modot.org/about/Tracker.htm

STEP 2.2.3	Gather information through benchmarking

Figure 2-18: Customer Satisfaction as a Performance Measure

Source: Tracker: Measures of Departmental Performance[29]



*2010-11 – Lincoln Mercury, 2012 – Apple, Inc., 2013 – Mercedes Benz, 2015 – Chick-fil-A.

Benchmarking: Performance Measure Definitions Matter

It is not uncommon for elected officials and oversight bodies to ask public agencies how proposed performance targets compare to their peer agencies. When the WMATA Board of Directors asked agency staff to defend the proposed bus on-time-performance targets to peer transit agencies, WMATA staff found themselves in a difficult situation. At the time, no industry standard definition existed for how to measure on-time performance. WMATA staff found wide diversity in the definitions used even by bus systems operating in the same area (see Figure 2-19 below). Given the absence of a consistent definition, WMATA staff recommended that the agency benchmark against itself to document improving or deteriorating on-time performance and establish targets based on baseline trends. The WMATA Board agreed to the staff recommendation.

[29] Missouri Department of Transportation. (2016). Tracker: Measures of Departmental Performance. Jefferson City, MO. http://www.modot.org/about/documents/April2016Tracker.pdf

STEP 2.2.3	Gather information through benchmarking

Figure 2-19: Comparative Benchmarking for On-time Performance

Source: Bus Performance Board Nov. 2010[30]

AGENCY	EARLY	LATE	Avg. OTP CY 2009
Metro	2 minutes	7 minutes	75.2%
Ride On	1 minutes	5 minutes	79.0%
The Bus	2 minutes	7 minutes	77.1%
CUE	2 minutes	5 minutes	81.5%
SEPTA	0 minutes	4 minutes	76.3%
MDT	59 seconds	4 minutes + 59 seconds	79.8%
MARTA	0 minutes + 30 seconds	5 minutes + 30 seconds	70.7%
MTA New York City	1 minute	5 minutes	* Does not report OTP to the Board or public

Linkages to Other TPM Components

Component A: Organization and Culture

Component B: External Collaboration and Coordination (See TPM Framework)

Component C: Data Management

Component 06: Reporting and Communication

STEP 2.2.4	Reflect external stakeholder interests

Description

An important input for the target setting business process is listening to external stakeholders. Reflecting their interests and perspectives in agency targets helps foster positive working relationships and build support.

WHO ARE THE EXTERNAL KEY PLAYERS?

- General public
- Elected officials
- Businesses
- Partners, such as MPOs, regional organizations, and local jurisdictions
- Third-party organizations, such as advocacy groups that could shape the reception of the target and/or its public face

Gathering feedback from external stakeholders is a common practice as part of agency's planning processes. However, what is newer is the reflection of those external viewpoints in

[30] Washington Metropolitan Area Transit Authority. (2011). Bus Performance Board Nov. 2010. Washington, DC.

STEP 2.2.4	Reflect external stakeholder interests

the setting of agency targets. In this new environment, it is important to acknowledge that the level of involvement of an external stakeholder and the nature of that involvement varies. For example, the general public may be "aware" of pavement condition issues, but an elected official could be a "policy changer" through directing additional funds to asset maintenance activities.

Items to keep in mind include:

- Collecting feedback on tolerable performance thresholds
- Piggy-backing on existing meetings
- Developing educational material

Note: *Collaboration with external stakeholders to set agency targets will be detailed in External Collaboration and Coordination (Component B).*

Examples

Understanding Public Priorities: MnDOT

During the develoment of their 2014-2033 Minnesota State Highway Investment Plan (MnSHIP), the agency conducted nine stakeholder meetings, conducted educational webinars, and created a new online interactive toolkit (see Figure 2-20 below) to better understand what performance levels stakeholders expected. Three scenarios were shared with the public representing a different mix of strategies, funding allocation, and outcomes. In addition, the public were asked to prioritize all investment categories (e.g., pavement, safety, bridge condition). The results from these external engagement efforts was then used to revise the agency's performance targets.

> "Our public engagement effort gave us valuable guidance on where MnDOT should focus our efforts and in turn how to set our performance targets."
>
> - Deanna Belden, Minnesota DOT

Understanding tolerable thresholds: MoDOT

Missouri DOT's customer report card includes an "importance-satisfaction" analysis that plots the percentage of Missourians who indicated a service offered by MoDOT is very important against the percentage of Missourians who were very satisfied (or dissatified) with that service. The simple graphic gives MoDOT direction on where to focus transportation resources. For example, in 2010 when the agency was facing a notable funding shortfall, the importance-satisfaction chart highlighted an opportunity to shift resources from one service to another. As the figure below from 2010 illustrates, Missourians were relatively satisfied with MoDOT's mowing/trimming services, but overall this was of less importance to

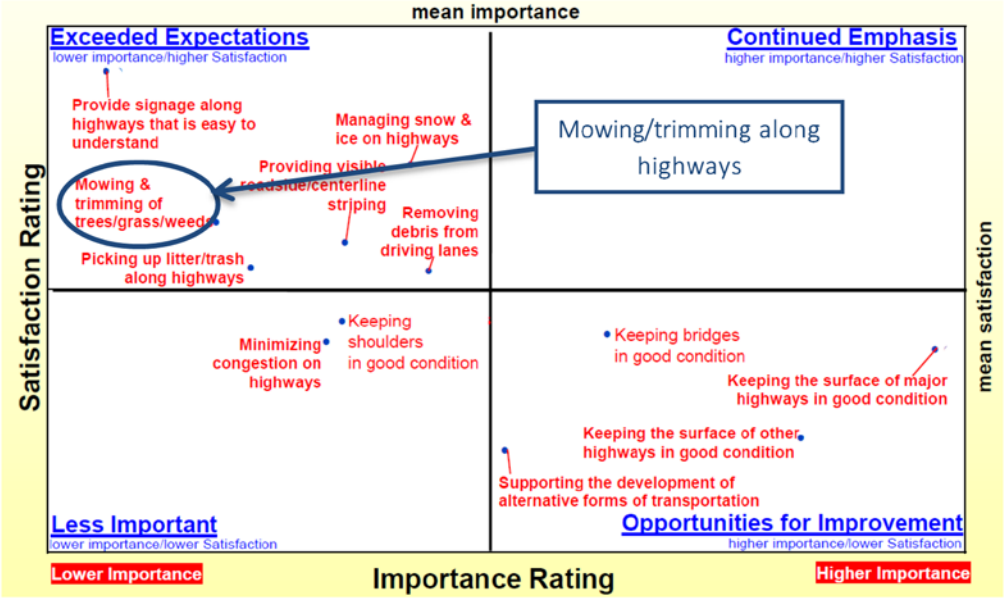
> "Public opinion surveys can also be helpful in the target-setting process to understand the relationship between different transportation system performance levels and the level of inconvenience or discomfort perceived by users."
>
> Source: NCHRP 551: Performance Measures and Targets for Transportation Asset Management (Vol II, pg. 34)

STEP 2.2.4	Reflect external stakeholder interests

citizens than other services. Subsequently, MoDOT reduced its mowing practices from four to three times a year resulting in $2.5 million in savings that was reallocated to other system performance areas. The next survey showed this maintenance practice change had zero effect on customer satisfaction.

Figure 2-20: Satisfaction v. Importance of Agency Activities

Source: Adapted from A Report Card From Missourians (2010)[31]



Linkages to Other TPM Components	Component 03: Performance-Based Planning Component 06: Reporting and Communication (See TPM Framework) Component B: External Collaboration and Coordination

STEP 2.2.5	Document the business process

Description

The collaborative business process for setting targets has been developed and now must be documented. The completion of this step means that staff within an agency has a clear understanding of their role in setting targets, the purpose of the targets, and an approach to reflect the interests of external stakeholders. The documentation of the business process will serve as a rulebook and record of how the process was conducted, justification for the final targets, and an explanation about why this approach was used. Documentation is not the most exciting aspect of target setting, but ensures the business process is replicable from cycle to cycle, can withstand staff turnover, and establishes an air of transparency around target setting. Material from this document can also be used to communicate with internal staff and external stakeholders the agency's target-setting business process.

[31] Missouri Department of Transportation. (2010). A Report Card From Missourians – Appendix A: I-S Analysis. Jefferson City, MO. https://library.modot.mo.gov/RDT/reports/Rd08018/or11001apdxA.pdf

STEP 2.2.5	Document the business process

As an agency goes through multiple cycles of target setting, the documentation must be updated. For example, as agency staff becomes more comfortable with target setting, more areas of the agency may want to get involved, thus enhancing collaboration and the integration of transportation performance management practices across the agency. Target setting, like many TPM components, is an iterative process; it is critical to document any steps that were taken and adjustments made to an agency's business process.

> Targets should not be set in stone, but periodically re-examined and adjusted based on documented reasoning.

Topics to address in the technical methodology documentation include:

- Roles and responsibilities of internal agency staff
- Outline of business process milestones and schedule
- Process flow map
- Adjustments to process to implement in next target-setting cycle
- Specific issues related to each implementation step (see Table 2-8)

Table 2-10: Topics to Address in Business Process Documentation

Source: Federal Highway Administration

Business Process Step	Topics to Document
Assign internal roles and responsibilities	• Roles and responsibilities • How targets will be used internally • Approval process for targets
Clarify purpose of the target	• Target audience • Target type
Gather information through benchmarking	• Criteria used to identify peer agencies (if used) • Justification for inclusion of "best in class" (if used)
Reflect external stakeholder interests	• Public engagement activities • Linkage between target setting process and existing public engagement activities

Examples

Business Process Descriptions

The following descriptions were adapted from State DOT responses to a survey distributed prior to the AASHTO Standing Committee on Performance Management (SCOPM) MAP-21 Target-Setting Workshop held in June 2013.

Description 1

In conjunction with each statewide long-range plan, a Governor-appointed external oversight body works with agency staff to determine appropriate targets for five to 25 years. In this iterative process, staff first reach consensus on recommended targets and then engage in back and forth discussion with the Commission over several months. The inclusion of input from other external stakeholders adds a month or two to the process.

STEP 2.2.5	Document the business process
	Description 2 System performance area staff use data to identify needs, planning program staff provide traffic growth projections, results based on different scenarios established, final draft targets reviewed and approved by Executive staff with consensus from Chief Engineer/Field Division Engineers, final draft targets submitted to external oversight body for final approval. Process is marshaled along by an internal performance working group. *Description 3* Technical asset management group develops proposed targets that will be vetted through senior executive steering committee. This is an iterative process allowing functional areas the flexibility of proposing achievable targets while enabling the senior executive steering committee to provide oversight and direction until achieving objectives that are aligned with Department goals. *Description 4* Technical experts make recommendations to the executive group – which considers policy implications and implementation actions. The Statewide Congestion Working Group discusses the technical and policy aspects of target setting. *Description 5* Technical asset group at Headquarters works with regional asset managers to review data and ensure accurate reporting before projecting performance at various funding levels. Headquarters group then works with the planning and finance groups to develop forecasts for various long-term funding scenarios. For annual budget setting, these scenarios are initially presented to Senior Management including the Executive Director and Chief Engineer, and once approved to an external oversight body. Proposed targets are revisited when final budgets are established by the legislature, then signed by the Governor. The forecasted condition at the approved budget is by default the annual target. Long-range targets, however, continue to fall back to the most recent Statewide long-range plan.
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework) Component B: External Collaboration and Coordination Component 03: Performance-Based Planning Component 04: Performance-Based Programming Component 06: Reporting and Communication

RESOURCES

General Resources	Year	Link
TPM Toolbox	2016	www.tpmtools.org
Target Setting Peer Exchange	2014	https://www.planning.dot.gov/Peer/Arizona/scottsdale_6-17-14_FHWA_target_setting.pdf
Transforming Performance Measurement for the 21st Century	2014	http://www.urban.org/sites/default/files/alfresco/publication-pdfs/413197-Transforming-Performance-Measurement-for-the-st-Century.PDF
SCOPM Task Force Findings on MAP-21 Performance Measure Target-Setting	2013	http://scopm.transportation.org/Documents/SCOPM%20Task%20Force%20Findings%20on%20Performance%20Measure%20Target-Setting%20FINAL%20v2%20(3-25-2013).pdf
Performance-Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
AASHTO SCOPM Target-Setting Workshop	2013	http://sites.spypondpartners.com/targetsetting/workshop/slides/00-notes.pdf
NCHRP Report 666: Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_666.pdf
A Performance Management Framework for State and Local Government	2010	http://www.gfoa.org/sites/default/files/APerformanceManagementFramework.pdf
NCHRP Report 551: Performance Measures and Targets for Transportation Asset Management	2006	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_551.pdf
Transportation Performance Management Awareness (FHWA-NHI Course #138001)		https://www.nhi.fhwa.dot.gov/training/course_search.aspx?tab=0&key=Transportation+Performance+Management&sf=0&course_no=138001
Introduction to Performance Measurement (FHWA-NHI Course #138003)		https://www.nhi.fhwa.dot.gov/training/course_search.aspx?tab=0&key=Transportation+Performance+Management&sf=0&course_no=138003
FHWA Office of Transportation Performance Management	2011	http://www.fhwa.dot.gov/tpm/

Safety Resources	Year	Link
Urbanized and Nonurbanized Safety Target Setting: Final Report	2015	http://safety.fhwa.dot.gov/hsip/tpm/fhwasa15067/
Safety Target Setting Final Report	2013	http://safety.fhwa.dot.gov/hsip/spm/docs/safetyfinalrpt.pdf
A Compendium of State and Regional Safety Target Setting Practices	2013	http://safety.fhwa.dot.gov/hsip/spm/docs/compendium.pdf
Safety Target Setting Peer Exchange	2013	http://safety.fhwa.dot.gov/hsip/spm/docs/peer_exchange.pdf
Performance Management Practices and Methodologies for Setting Safety Performance Targets, Literature Review	2011	http://safety.fhwa.dot.gov/hsip/spm/docs/literature_review.pdf

ACTION PLAN

1. Of the TPM sub-components discussed in this chapter, which one would you like to work on?

   ❑ 2.1 Technical Methodology ❑ 2.2 Business Process

2. What aspect of the TPM process listed above do you want to change?

3. What "steps" discussed in this chapter do you think could help you address the challenge noted above?

Technical Methodology

- ❑ Establish a baseline
- ❑ Analyze historical trends
- ❑ Identify influencing factors and assess risk (internal and external)
- ❑ Define target parameters
- ❑ Forecast future performance
- ❑ Document technical methodology

Business Process

- ❑ Assign internal roles and responsibilities
- ❑ Clarify purpose of the target
- ❑ Gather information through benchmarking
- ❑ Reflect external stakeholder interests
- ❑ Document the business process

4. To implement the "step" identified above, what actions are necessary, who will lead the effort and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success?

6. Who is someone (internal and/or external) I will collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

TABLE INDEX

EQUATION INDEX

U.S. Department of Transportation
Federal Highway Administration

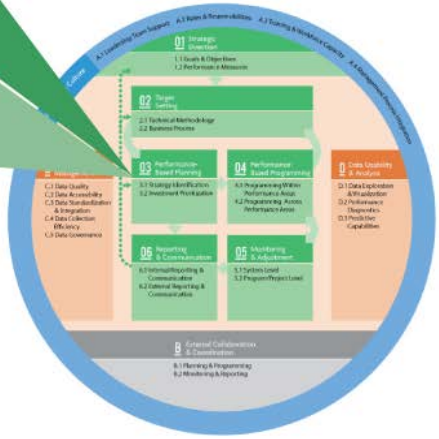
COMPONENT 03

PERFORMANCE-BASED PLANNING

This chapter provides assistance to transportation agencies with the "Performance-Based Planning" component of Transportation Performance Management (TPM). It discusses where performance-based planning occurs within the TPM Framework, describes how it interrelates with the other nine components, presents definitions for associated terminology, provides links to regulatory resources, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for performance-based planning may differ from what is included in this chapter.

03 Performance-Based Planning

3.1 Strategy Identification
3.2 Investment Prioritization



Performance-Based Planning is the use of agency goals and objectives and performance trends to drive the development of strategies and priorities in the long-range transportation plan and other performance-based plans and processes. The resulting planning documents become the blueprint for how an agency intends to achieve its desired performance outcomes.

INTRODUCTION

Performance-based planning is an integral component within transportation performance management, a strategic approach that uses data to support decisions that help to achieve performance goals. Performance-based planning is the use of a strategic direction (goals and objectives) and performance trends to drive the development of agency strategies and priorities in the long-range transportation plan (LRTP) and other performance-based plans (e.g., safety, asset management, mobility/operations and freight). The identified strategies and priorities in these plans lead to the programming of projects selected to make progress toward performance targets, objectives and goals.

The main distinctions between a performance-based planning approach and a non-performance-based approach are:

1. The use of performance trends to identify areas of focus and evaluate portfolios of strategies;
2. Clear linkage between strategies and goals to determine investment priorities; and
3. The identification of the relative priority of strategies.

Performance-based planning builds on the foundation established by the Strategic Direction (Component 01) and Target Setting (Component 02). The planning process provides a forum to discuss, both internally and externally, how to turn strategic goals into actions on the ground. For each strategic goal, agencies examine performance trends to identify focus areas, derive strategies to address performance challenges and/or maintain existing results, and analyze alternative scenarios. Ensuing tradeoff discussions determine which strategies will be pursued and become concrete projects during the programming phase. The resulting planning documents become the blueprint for how an agency intends to achieve its goals and in turn its desired performance levels.

Performance-based planning is based on several main ingredients:

- **Data and measures:** Data and measures used to establish targets (Component 02) will be documented, reiterated within performance-based plans, and used to drive the development of strategies;
- **Stakeholder input:** Along with data, the plans are developed with visioning input from public engagement and the input of external partners;
- **Policy considerations:** Identified strategies must reflect the policies and procedures of local, state, and Federal partners; and
- **Sharing data and information among silos:** By its nature, the planning process facilitates communication and understanding among silos of expertise. The evaluation of strategies across performance areas requires open communication and exchange of information to better understand tradeoffs and the likelihood of success within a particular context.

While developing performance-based plans, agencies need to maintain a strong linkage to their strategic goals and study how these plans will guide programming. Planning involves the identification of strategies that are included in a variety of documents, which together drive the selection of projects in the programming phase. These two elements (planning and programming) of transportation performance management are combined and discussed in depth in FHWA's "*Performance Based Planning and Programming Guidebook*."[1]

> Performance-based planning and programming (PBPP) refers to the application of performance management within the planning and programming processes of transportation agencies to achieve desired performance outcomes for the multimodal transportation system. This includes a range of activities and products undertaken by a transportation agency together with other agencies, stakeholders, and the public as part of a 3C (cooperative, continuing, and comprehensive) process. It includes development of:

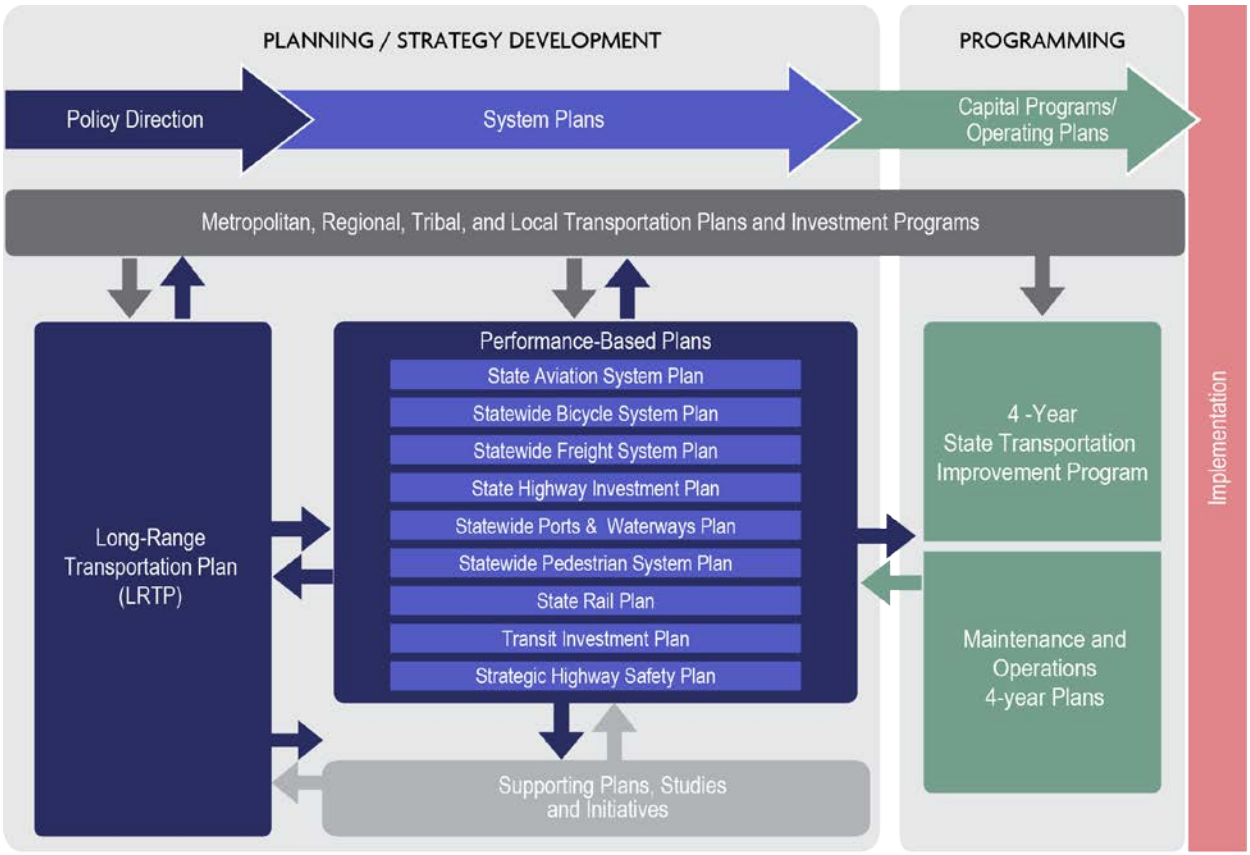
[1] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.

long range transportation plans (LRTPs), other plans and processes (including those Federally-required, such as Strategic Highway Safety Plans, Asset Management Plans, the Congestion Management Process, Transit Agency Asset Management Plans, and Transit Agency Safety Plans, as well as others that are not required), and programming documents, including State and metropolitan Transportation Improvement Programs (STIPs and TIPs). PBPP is intended to ensure that transportation investment decisions are made - both in long-term planning and short-term programming of projects - based on their ability to meet established goals.

While the PBPP Guidebook discusses these elements together because of their extensive linkages, this TPM Implementation Guidebook separates them to articulate the unique implementation steps related to planning (Component 03) versus programming (Component 04). As demonstrated in Figure 3-1, planning starts agencies down the path toward implementation through the development of long-range and other performance-based plans. The resulting family of planning documents is then fed into programming activities to create the state transportation improvement program, business plans and budget documents.

Figure 3-1: Model of DOT Planning and Programming Relationships

Source: Adapted from Minnesota Department of Transportation's Family of Plans[2]

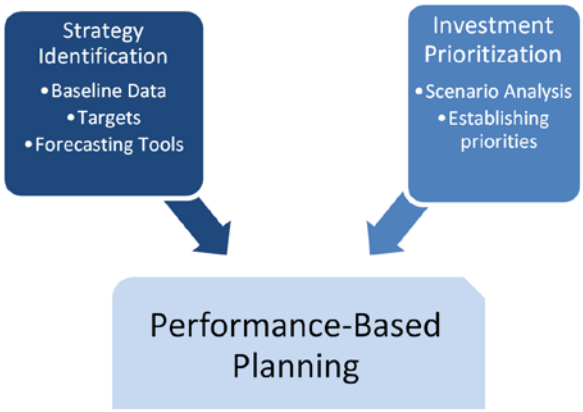


[2] Minnesota Department of Transportation - Family of Plans. June 3, 2016. http://www.dot.state.mn.us/minnesotago/index50yearvision.html

SUBCOMPONENTS AND IMPLEMENTATION STEPS

Figure 3-2: Subcomponents for Performance-Based Planning

Source: Federal Highway Administration



The definition of performance-based planning is: The use of agency goals and objectives and performance trends to drive the development of strategies and priorities in the long-range transportation plan and other performance-based plans and processes. The resulting planning documents become the blueprint for how an agency intends to achieve its desired performance outcomes. The performance–based planning component is comprised of two subcomponents as Illustrated in Figure 3-2:

- **Strategy Identification:** The development of a range of strategies for achieving desired outcomes through the use of available baseline data trends, forecasting tools, economic analysis tools, and management systems (e.g., pavement management system). Strategies may include operational, expansion, asset management, and enhancement approaches.
- **Investment Prioritization:** The evaluation of tradeoffs across alternative investment scenarios based on consideration and comparison of their impacts on performance targets and goals.

Strategy identification is where agencies answer the question, "*How will we achieve our agreed-upon goals, objectives and targets"?* By examining performance trends and using a range of forecasting tools during the target setting process (Component 02), agencies evaluate different approaches to making progress toward the goals identified in the Strategic Direction (Component 01). Once a menu of strategies has been developed, agencies begin to bundle strategies under different scenarios to assess tradeoffs across performance areas through the investment prioritization process. The risks associated with individual strategies and portfolios of strategies are also evaluated to determine the likelihood of unforeseen events impacting (positively and negatively) the predicted outcomes. To provide direction for the selection of projects, agencies determine the relative priority of different goals and performance outcomes. The resulting planning documents outline an investment prioritization method from which future programming decisions can be made. Table 3-1 lists the steps necessary to implement performance-based planning.

Table 3-1: Performance-Based Planning Implementation Steps

Source: Federal Highway Administration

Strategy Identification	Investment Prioritization
1. Clarify internal and external roles and responsibilities for effective collaboration	1. Assign internal roles and responsibilities
2. Identify key performance issues for each strategic goal and objective	2. Develop scenarios to evaluate strategies
3. Assess a strategy's effect on outcomes	3. Establish relative importance of strategic goals to guide strategy prioritization
4. Define and evaluate strategies against desired characteristics	4. Document investment prioritization process
5. Document strategy identification process	

Performance-based planning should be viewed as an exploratory exercise, with creativity welcomed but firmly grounded in performance data, strategic goals, and risk assessment. The planning process encourages discussion and exploration, but rests on an analysis of influencing factors and a prioritization process that is well understood by stakeholders. The resulting plans should clearly communicate strategies that will be used to attain targets established during target setting (Component 02).

CLARIFYING TERMINOLOGY

Table 3-2 presents the definitions for the performance-based planning terms used in this Guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table 3-2: Performance-Based Planning: Defining Common TPM Terminology

Source: Federal Highway Administration

Common Terms	Definition	Example
Goal	A broad statement of a desired end conditions or outcome; a unique piece of the agency's vision.	A safe transportation system.
Objective	A specific, measurable statement that supports achievement of a goal.	Reduce the number of motor vehicle fatalities.
Risk	Threats to and opportunities for achieving strategies, goals, and targets.	An extreme weather event causes unanticipated costs.
Strategy	A well-defined pathway toward reaching a target, goal, or objective.	Increasing bridge inspections to decrease % falling into SD category.
Target	Level of performance that is desired to be achieved within a specific time frame.	Two % reduction in the fatality rate in the next calendar year.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.
Visioning	The process of setting or confirming goals and objectives.	Envisioning the characteristics of a transit agency providing equitable, efficient, and dependable service.

RELATIONSHIP TO TPM COMPONENTS

The ten TPM components are interconnected and often interdependent. Table 3-3 summarizes how each of the nine other components relate to the performance-based planning component.

Table 3-3: Performance-Based Planning Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to Performance-Based Planning
01. Strategic Direction	The establishment of an agency's focus through well-defined goals/objectives and a set of aligned performance measures.	The purpose of the strategies developed during the performance-based process is to make progress toward the goals and objectives defined under the strategic direction.
02. Target Setting	The use of baseline data, information on possible strategies, resource constraints and forecasting tools to collaboratively establish targets.	Targets define the results the strategies in the plans are striving to achieve.
04. Performance-Based Programming	Allocation of resources to projects to achieve strategic goals, objectives and performance targets. Clear linkages established between investments made and their expected performance outputs and outcomes.	Performance-based planning develops the criteria for prioritizing projects for programming, and for evaluating the efficacy of the delivered projects.
05. Monitoring and Adjustment	Processes to monitor and assess actions taken and outcomes achieved. Establishes a feedback loop to adjust programming, planning, and benchmarking/target setting decisions. Provides key insight into the efficacy of investments.	Strategy Identification (subcomponent 3.1) is informed by the analysis of the effectiveness of alternative strategies (before/after analysis) with respect to established goals. Monitoring provides crucial insights about what adjustments are necessary and when new strategies are needed.
06. Reporting and Communication	Products, techniques and processes to communicate performance information to different audiences for maximum impact.	Planning documents provide an opportunity not only to communicate agency goals and objectives, but also to clarify "how" an agency proposed to make progress toward agreed upon performance outcomes.
A. TPM Organization and Culture	Institutionalization of a TPM culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support TPM.	The performance-based planning process provides a forum to discuss internally and externally how to turn strategic goals into actions on the ground. A collaborative planning process is important to foster buy-in internally and externally to agency programming decisions.
B. External Collaboration and Coordination	Established processes to collaborate and coordinate with agency partners and stakeholders on planning/ visioning, target setting, programming, data sharing, and reporting.	Performance-based planning is a collaborative process through which strategies are jointly developed with external partners. Resulting planning documents reflect regional policies and priorities.

Component	Summary Definition	Relationship to Performance-Based Planning
C. Data Management	Established processes to ensure data quality and accessibility, and to maximize efficiency of data acquisition and integration for transportation performance management.	High quality data must be gathered and made available for monitoring system conditions and evaluating the impacts of previous strategies in order to feed this information into the ongoing cycle of planning, which informs the prioritization of strategies.
D. Data Usability and Analysis	Existence of useful and valuable data sets and analysis capabilities, provided in usable, convenient forms to support TPM.	The usability of data and its place in developing quality analyses plays a significant role in the ability to determine strategies toward reaching agency targets.

REGULATORY RESOURCES

This Guidebook is intended to assist agencies with implementing transportation performance management in a general sense, and not to provide guidance on compliance and fulfillment of Federal regulations. However, it is important to consider legislative requirements and regulations when using the Guidebook. In many cases, use of this Guidebook will bring an agency in alignment with Federal requirements; however, the following sources should be considered the authority on such requirements:

Federal Highway Administration

- Transportation Performance Management: http://www.fhwa.dot.gov/tpm/links_fhwa.cfm
- Fact Sheets on Fixing America's Surface Transportation (FAST) Act: https://www.fhwa.dot.gov/fastact/factsheets/
- Fact Sheets on Moving Ahead for Progress in the 21st Century (MAP-21): https://www.fhwa.dot.gov/map21/factsheets/
- Resources on MAP-21 Rulemaking: https://www.fhwa.dot.gov/tpm/rule.cfm

Federal Transit Administration

- Fact Sheets on FAST Act: https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-fast-act
- Resources on MAP-21: https://www.transit.dot.gov/regulations-and-guidance/legislation/map-21/map-21-program-fact-sheets

ASSESSING RISK

Risk refers to the positive or negative effects of uncertainty or variability of any influencing factor (both threats and opportunities) to achieving strategies, goals, and targets. Given that performance-based planning focuses on future outcomes, the inclusion of risk in the development of strategies and investment prioritization is crucial. Assessing and managing risk means determining the likelihood of influencing factors occurring, as well as understanding and planning for their associated impacts. This is a key consideration in any planning effort, as part of those plans must address impacts that could cause them to derail. Risks may be positive or negative and generally can be defined as hazard, financial, operational, or strategic risks as summarized in Table 3-4.[3] Risk is discussed at length in NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance (2015) and FHWA's Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities (2012).

Table 3-4: Summary of Key Definitions of Risk Types

Source: Federal Highway Administration

Risk Type	Definition	Management
Hazard	The risk of uncertain performance due to condition and/or age of infrastructure or vulnerability to extreme events.	Addressed via contingency funding, specific strategies regarding improving condition, or reducing vulnerability to weather events. These may include prioritizing projects to achieve state of good repair (SGR), simulating deterioration probabilities, or constraining project list to the most critical.
Financial	The risk of a financial shift, such as a cut in revenues or a change in project cost.	Addressed via revenue source and trade-off understanding and simulation of various investment levels.
Operational	The risk that a prediction or strategy is incorrectly calibrated, leading to issues such as inaccurate forecasts or a lack of intended impact.	Addressed by a good feedback loop and review of forecasting abilities.
Strategic	The risk that management or specific programs have unforeseen weaknesses impacting the achievement of their intended purpose.	Addressed by understanding the sensitivity of performance preferences, targets, and resource allocation strategies. Strategy options may include silo versus integrated management, fixed versus flexible budget allocation, and worst first versus proactive preservation.

To guide the risk assessment and management piece of performance-based planning, consider the steps outlined as an International Organization for Standardization standard (ISO 31000)[4] and used by the FHWA *Risk-Based Transportation Asset Management* guide (Figure 3-3). This can be a formal or informal process.

- **Establish the context:** Understanding the social, legislative, economic, and environmental factors that may impact the agency or a particular goal, strategy, or target. This is an analogous step to the factor assessment that takes place for target setting.

[3] Definitions summarized from *NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance,* pg. 20. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

[4] ISO 31000 – Risk Management. http://www.iso.org/iso/home/standards/iso31000.htm

- **Identify risk:** Determine which type of risk is possible out of the options above.
- **Analyze risk:** Understand the probability of the risk and its impact. This can be a basic understanding or rating, or it can be modeled for a more specific analysis.
- **Evaluate risk:** Recognize the sensitivity of the agency to the impacts; interpret the severity of the impacts that the risk may cause.
- **Manage risk:** "Treat, tolerate, terminate, transfer, or take advantage of the risk."[5] In the context of performance-based planning, this means incorporating these steps into the planning process and developing strategies with an understanding of the risks, moving forward into the programming stage with flexibility to accommodate the kind of risks described above.

Figure 3-3: Risk Management Complements Other Management Frameworks

Source: Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities[6]

[5] New York State Department of Transportation. (2014). Transportation Asset Management Plan Draft v 05-02-14 (External Review). http://www.tamptemplate.org/wp-content/uploads/tamps/023_newyorkstatedot.pdf

[6] Federal Highway Administration. (2012). Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities. http://www.fhwa.dot.gov/asset/pubs/hif12035.pdf

IMPLEMENTATION STEPS

3.1 STRATEGY IDENTIFICATION

The following section outlines steps agencies can follow to define strategies aimed at progressing toward performance goals, and building a list of potential projects to be programmed in the performance-based programming component (Component 04).

1. Clarify internal and external roles and responsibilities for effective collaboration
2. Identify key performance issues for each strategic goal and objective
3. Assess a strategy's effect on outcomes
4. Define and evaluate strategies against desired characteristics
5. Document strategy identification process

> "Planning provides a state DOT with the skills to define a consensus-based, collaborative, long-term vision for transportation reflecting the perspectives of both internal [staff] and external stakeholders."
>
> Source: NCHRP Report 798: The Role of Planning in a 21st Century State DOT—Supporting Decisionmaking

STEP 3.1.1	Clarify internal and external roles and responsibilities for effective collaboration

Description

The planning process begins when the roles and responsibilities are defined. This often results in the formation of a task force or leadership committee, representing diverse performance areas of the organization. It should be well supported by, and connected with, agency leadership. It is important to establish the momentum and mutual understanding of a continual effort, as performance-based planning provides direction for programming decisions.

The diverse group assembled should foster a collaborative approach and enable the evaluation of strategies across multiple goals and performance targets. This also is designed to result in the development of a broad array of strategies. In order to reflect regional context and align regional planning processes, the group should collaborate with and learn from external partners.

Table 3-5: Key Roles to Determine

Source: Federal Highway Administration

Process Leadership	Lead, coordinate, and marshal the performance-based planning process.
Input Providers	Drive the conversation by making recommendations and suggestions for the duration of the process. Primarily internal staff but may also include external collaborators.
Feedback Contributors	Review recommendations and suggestions, but for sake of expediency, provide feedback on ideas rather than additional input.
Trackers	Collect and analyze data used to establish and monitor performance targets.
Decision Makers	Determine and decide the final strategies for inclusion.

STEP 3.1.1	Clarify internal and external roles and responsibilities for effective collaboration
	The PlanWorks resource created by FHWA is a valuable tool for use throughout the planning process, and includes information relevant to assigning roles and responsibilities.[7] It is essential that the above roles have a common understanding of how the plan will be formed, how strategies will be developed, prioritized, and included, and how the final plan will be used and communicated. All participants must also understand who is charged with decision-making and accountability, to ensure a clear chain of command and preclude confusion and false starts. **Items to tackle while assigning internal roles and responsibilities include:** • Identify key groups and champion for each • Determine ownership of each step • Ensure common understanding and support of framework • Confirm timeline and expectations
Examples	Colorado's **Statewide Transportation Plan (2015-2040)** provides an example of the involvement of many different groups:[8] **Transportation Commission: (process leadership)** Provides a policy directive, revenue projections, and continuity of leadership into programming (and with DOT goals and objectives). Commissioners serve in a leadership capacity as a board of directors for CDOT. The commission is comprised of 11 commissioners who represent specific districts. Each commissioner is appointed by the Governor, confirmed by the Senate, and serves a four-year term. To provide continuity, the commissioners' term expiration dates are staggered every two years. **DOT staff: (input providers, feedback contributors)** For each of the agency's performance areas, including safety, mobility, economic vitality/ planning, and maintenance. **Statewide Transportation Advisory Committee (STAC): (input providers, feedback contributors)** A group of elected or appointed officials representing five metropolitan planning organizations (MPOs) and 10 rural Transportation Planning Regions throughout the state. **Advocacy groups: (input providers, feedback contributors)** Rocky Mountain Wild, Colorado Natural Heritage Program, Southwest Energy Efficiency Project, The Nature Conservancy **State and Federal agencies represented: (feedback contributors)** • Federal Highway Administration (FHWA)

[7] FHWA. PlanWorks, LRP-1: Approve Scope of LRTP Process. https://fhwaapps.fhwa.dot.gov/planworks/DecisionGuide/Step/1
[8] Colorado DOT. (2015). Transportation Matters: Statewide Transportation Plan 2040 Executive Summary. http://coloradotransportationmatters.com/wp-content/uploads/2015/07/CDOT-SWP-Executive-Summary-2015-07-01.pdf

STEP 3.1.1	Clarify internal and external roles and responsibilities for effective collaboration

- US Bureau of Land Management (BLM)
- Colorado Department of Public Health and Environment (CDPHE)
- US Fish and Wildlife Service (FWS)
- State Historic Preservation Office (SHPO)
- US Department of Housing and Urban Development (HUD)
- Federal Transit Authority (FTA)

Tribal Governments: (input providers, feedback contributors)

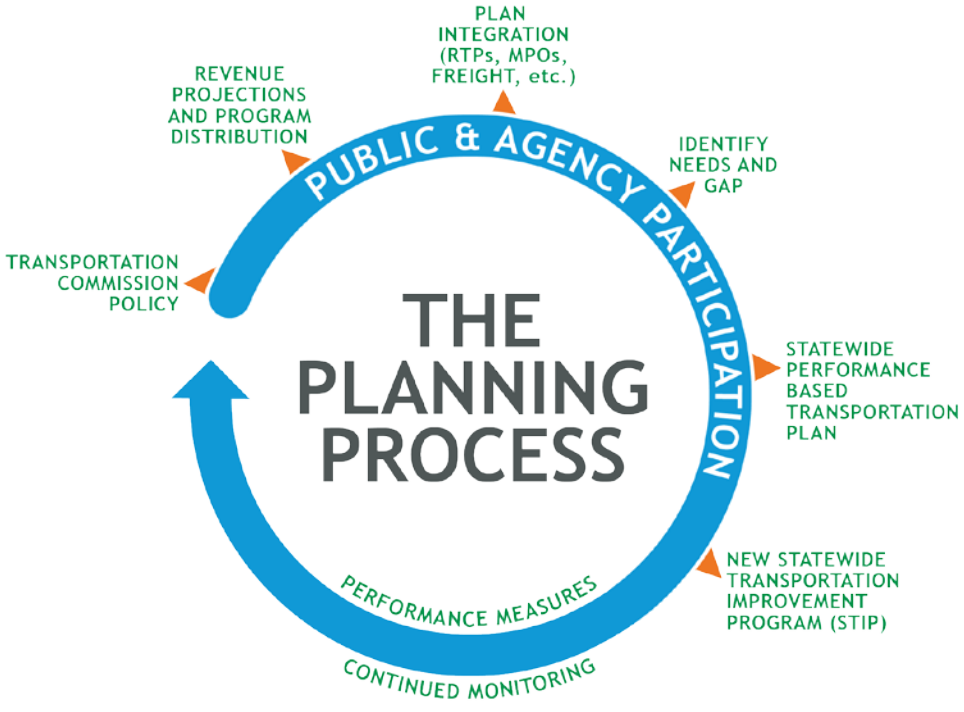
Southern Ute Tribe, Ute Mountain Ute Tribe

Public: (feedback contributors)

Over 60,000 members of the public provided input.

Figure 3-4: The Planning Process Cycle

Source: Transportation Matters: Statewide Transportation Plan 2040 Executive Summary[9]



The role of each group can be seen in the planning process graphic from the CDOT plan. The Transportation Commission, as process leadership, kicks off the planning process with their policy directive. They also contribute the revenue projections and program distribution. Then the STAC and other organizations bring their own plans and input to the table, identifying needs and gaps. The final plan is then approved and adopted by the Transportation Commission.

[9] Colorado DOT. (2015). Transportation Matters: Statewide Transportation Plan 2040 Executive Summary. http://coloradotransportationmatters.com/wp-content/uploads/2015/07/CDOT-SWP-Executive-Summary-2015-07-01.pdf

STEP 3.1.1	Clarify internal and external roles and responsibilities for effective collaboration
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework) Component B: External Collaboration and Coordination

STEP 3.1.2	Identify key performance issues for each strategic goal and objective

Description

This step requires the examination of current performance results related to each strategic goal and objective to identify the performance needs to be addressed. Having S.M.A.R.T. objectives, as discussed in the PBPP Guidebook[10] and in Strategic Direction (Component 01), may help an agency determine key performance issues. Baseline information should be examined to provide context on key issues and trends, whether those trends are negative or positive, and the sources of the information.[11] An understanding of baseline data and past conditions, as well as future needs, is vital to identify where the plan's strategies should focus. For example, if baseline data on pavement condition showed declining trends, it would be flagged as a key concern. A resulting strategy could be to resurface a specific number of miles of pavement per year.

In addition to relying on baseline data, key issues or concerns may be driven by agency priorities (e.g., safety) or legislative mandates (e.g., % of structurally deficient bridges). To better understand the context of these key issues and concerns, and to anticipate potential future issues, the agency should review the internal/external factors identified during target setting. As a reference, the table below lists potential influencing factors for performance:

Table 3-6: Internal and External Factors Influencing Performance

Source: Federal Highway Administration

Internal	External
Funding	Economy
Staffing constraints	Weather
Data availability and quality	Politics/Legislative requirements
Leadership	Population growth
Capital project commitments	Demographic shifts
Cultural barriers	Zones of disadvantaged populations
Agency priorities	Vehicle characteristics
Agency jurisdiction	Modal shares
Senior management directives	Gas prices
Policy directives (e.g., zero fatalities)	Land use characteristics
Cross performance area tradeoffs	Driver behavior
Collaboration across agency	Traffic

[10] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[11] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC. Page 31.

STEP 3.1.2	Identify key performance issues for each strategic goal and objective

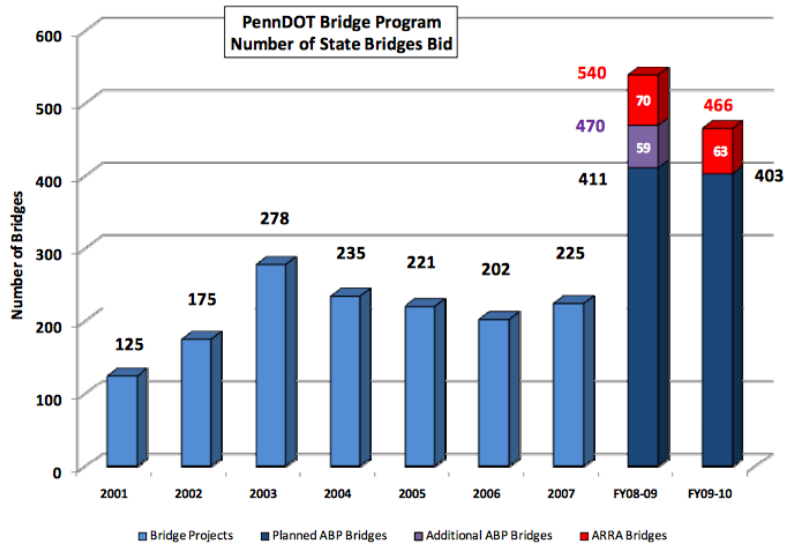
Examples

Pennsylvania Department of Transportation's Prioritization of Bridge Needs

With 25,000 state owned bridges, Pennsylvania has the third-largest number of bridges in the nation. The state has led with the highest number of bridges classified as structurally deficient (SD); at the peak, PennDOT had 6,034 SD bridges. Recognizing this as a key system issue, PennDOT identified bridge maintenance as a strategy to improving their bridge system condition. While the number of bridge projects bid upon between 2001 and 2007 varied between 125 and 278 per year, beginning in 2008-2010 the number increased significantly to 540, including those funded by Accelerated Bridge Program (ABP) and American Recovery and Reinvestment Act (ARRA) funding.[12]

Figure 3-5: 2010 Report Card for Pennsylvania's Infrastructure

Source: Bridges: 2010 Report Card for Pennsylvania's Infrastructure: Bridges[13]



While this means that bridge work did accelerate over the following years, it also means that resources directed toward bridges were not directed toward other areas, resulting in a tradeoff. As funds were funneled into maintenance, fewer resources were available for other areas such as mobility. As seen in Figure 3-6, below, during the time that funding was increasing for bridge repair, the percentage of mobility (capacity adding) projects of the total dropped dramatically.[14]

[12] Pennsylvania Department of Transportation. (2014). Bridges: 2014 Report Card for Pennsylvania's Infrastructure. http://www.pareportcard.org/PARC2014/downloads/PA_2014_RC_Bridges.pdf

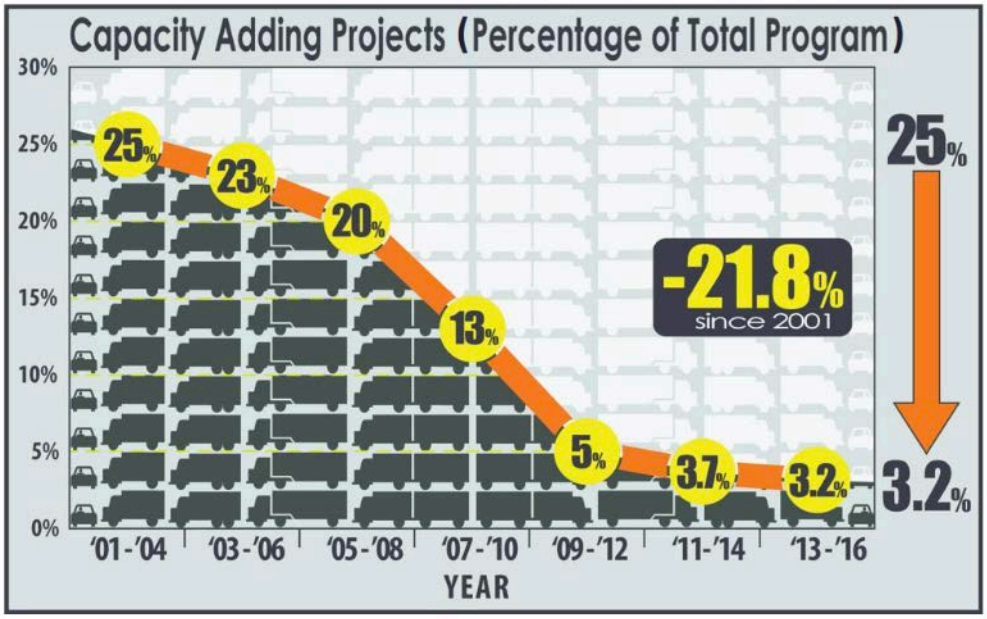
[13] Pennsylvania Department of Transportation. (2010). Bridges: 2010 Report Card for Pennsylvania's Infrastructure. http://www.pareportcard.org/PDFs/Bridges%20w%20Nat%20final.pdf

[14] Pennsylvania Department of Transportation. (2014). Bridges: 2014 Report Card for Pennsylvania's Infrastructure. http://www.pareportcard.org/PARC2014/downloads/PA_2014_RC_Bridges.pdf

STEP 3.1.2	Identify key performance issues for each strategic goal and objective

Figure 3-6: Data from the Pennsylvania Transportation Performance Report 2013

Source: Bridges: 2014 Report Card for Pennsylvania's Infrastructure [15]



This example illustrates how an agency develops strategies to address a prevalent performance issue and how those decisions can affect other performance areas. PennDOT prioritized repair to improve aggregate bridge condition over adding new capacity, a sensible approach since one must maintain what one builds. Nonetheless, this is a tradeoff: as a plus, they are working toward improving the total system condition; as a negative, they may be falling behind in adding capacity needed to keep up with demand.

Linkages to Other TPM Components

Component 01: Strategic Direction

Component 02: Target Setting (See TPM Framework)

Component 04: Performance-Based Programming

Component C: Data Management

Component D: Data Usability and Analysis

STEP 3.1.3	Assess a strategy's effect on outcomes

Description

In this step, agencies analyze how specific strategies will affect future performance outcomes using forecasting tools, economic analyses, and management systems. The purpose is to determine if a specific strategy provides the means to go from current conditions/baseline data toward achievement of performance goals. Agencies may find it beneficial to define various scenarios to test if the effect of a strategy may be to enhance or to throw off track.

[15] Pennsylvania Department of Transportation. (2014). Bridges: 2014 Report Card for Pennsylvania's Infrastructure. http://www.pareportcard.org/PARC2014/downloads/PA_2014_RC_Bridges.pdf

STEP 3.1.3	Assess a strategy's effect on outcomes
	In order to gain additional perspective on setting strategies, it is beneficial to review the efficacy of past strategies on achieving projected performance outcomes and making progress toward strategic goals. This before and after analysis will provide continuity between different iterations of long term plans. An agency's ability to assess strategies will depend on the resources (both staff time and tools) available. During this step, an agency assesses the risk regarding each strategy developed. Assessing risk means understanding the potential impacts of internal and external factors, their likelihood, and their severity for each strategy. Addressing risk means acknowledging these potential impacts and creating strategies that have the flexibility to accommodate these events or at least mitigate their effects. **Strategies are typically assessed in a range of planning documents:**[16] • MPO LRTP • State DOT LRTP • Asset management plans • State supporting planning documents (SHSP, state investment plan, etc.) • Non-metropolitan regional transportation planning organizations (often known as RTPOs or RPOs) • Transit operators, often through a transit development plan (TDP) • From local governments • Public "calls for projects" issued by State DOTs or MPOs
Examples	**Florida DOT's Road Ranger Program**[17] The Florida Department of Transportation (FDOT) recognized the need to address nonrecurring congestion caused by traffic incidents in order to make progress toward their mobility goal. A proposed strategy to address nonrecurring congestion was the development of the Road Ranger Program, a system of incident response that would address all districts along the Florida Turnpike. Between its implementation in 2000 and a study conducted in 2005, the FDOT Road Rangers provided more than two million assists to motorists over more than 1,000 centerline miles of Florida's busiest roadways. Assists include lane clearance and traffic control during incidents, fuel and tire changing assistance, cell phone calls for car service, and other quick fixes to get disabled vehicles off the freeway and reduce the potential for secondary incidents and extended resultant congestion. **To assess the efficacy of the Road Rangers as a strategy, FDOT collects the following performance measures:** • Number of assists provided to motorists • Number of miles of freeways covered • Incident duration • Travel time reliability • Customer satisfaction

[16] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[17] SHRP2. (2011). *Integrating Business Processes to Improve Travel Time Reliability* (SHRP2 Report S2-L01-RR-1). Washington, DC. http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L01-RR-1.pdf

STEP 3.1.3	Assess a strategy's effect on outcomes

FDOT has found that the Road Rangers patrols have a significant and cost-effective impact on these performance areas, saving 1,138,869 vehicle hours of delay and 1,717,064 gallons of fuel during the study period. FDOT also found that, although the program cost approximately $1.1 million statewide, it has added up to about $29.2 million in savings. The cost-benefit ratio is much better than other traditional mobility enhancement projects such as construction of new or expansion of existing roadways.[18]

Table 3-7: FDOT Road Ranger Program Analysis

Source: Federal Highway Administration

Category	Details
Performance Area	• Mobility
Performance Measurements	• Number of assists • Number of miles covered • Hours of delay • Incident duration • Additional gallons of fuel used • Customer satisfaction
Performance Goals	• Improve customer assistance and satisfaction • Reduce hours of delay • Reduce incident duration • Reduce fuel consumption
Target	• Specific numbers assigned to performance goals above
Strategy	• Provide free roadside assistance along the most travelled route in the state, 24/7
Results	• Positive impact on all performance measures • Excellent cost/benefit ratio

Linkages to Other TPM Components

Component 01: Strategic Direction

Component 02: Target Setting (See TPM Framework)

Component C: Data Management

Component D: Data Usability and Analysis

STEP 3.1.4	Define and evaluate strategies against desired characteristics

Description

This step ensures that the plan spells out a clear connection between strategies and strategic goals.

[18] State Traffic Engineering and Operations Office. Road Rangers: A Free Service Provided by the Florida Department of Transportation, http://www.dot.state.fl.us/trafficoperations/traf_incident/rrangers/rranger.shtm.

STEP 3.1.4	Define and evaluate strategies against desired characteristics

Define the characteristics of each strategy including:

- **Scope:** What is the geographic reach? What is the timeframe? (For strategies these can vary within the typical statewide 30-year scope of a plan document)
- **Owner:** Who is the leader of this strategy, who implements it, and who tracks it?
- **Mode:** Passenger, freight, automobile, pedestrian, etc.

Explain why the strategy will work, offering information to back up its importance and its anticipated effects. This builds on the data examined in the previous step to create a narrative fully explaining each strategy. Define the anticipated outcome, and determine how the outcome will be evaluated. Include how efficacy will be measured, linking back to performance measurements, and specifying the exact measures applying to each strategy. During evaluation, it should be easy to answer yes or no as to whether the goal was accomplished and the strategy was effective. An agency's ability to evaluate strategies will depend on the resources (both staff time and tools) available.

Examples

What Moves You Arizona, the Arizona Department of Transportation's statewide long-range transportation plan, was selected as a model LRTP by FHWA. One of the plan's many strengths is its connection between strategies and goals. Figure 3-7 below illustrates strategies under consideration by goal area and Figure 3-8 lists strategies that connect back directly to the agency's list of Goals and Performance levels. The plan defines each of the strategies, current usage and efficacy, and other information to illustrate the reasoning behind them. It also provides implementation strategies for each.

Figure 3-7: Building a Bridge between Goals and Strategic Plans

Source: What Moves You Arizona: Long-Range Transportation Plan 2010-2035[19]

Plan Goal Area	Potential Policies/Strategies
Mobility, Accessibility, and Connectivity	Access Management Complete Streets Methods, Models, and Data Research
Preservation and Maintenance	Expansion Maintenance and Operations Policy
Economic Development	Job creation/retention Access Management Complete Streets Demand Management System Modernization (Bottleneck Reduction, System Operations, Traffic Signal Timing)
Transportation and Land Use	Access Management
Natural, Cultural, and Environmental Resources	Context Sensitive Solutions Education and Outreach "Green" certification
Safety and Security	System Modernization (Rural Safety) Education (Distracted Driving, Seat Belt Usage)
Performance Measurement and Management	Methods, Models, and Data Research

[19] Arizona Department of Transportation. (2011). What Moves You Arizona: Long-Range Transportation Plan 2010-2035, *88*. http://www.azdot.gov/docs/default-source/planning/lrtp-2011-1129.pdf?sfvrsn=2

STEP 3.1.4	Define and evaluate strategies against desired characteristics

Figure 3-8: Measuring Goals with Performance Measures

Source: What Moves You Arizona: Long-Range Transportation Plan 2010-2035[20]

Plan Goal	Performance Measures
Improve Mobility and Accessibility	Congestion, speed, and travel delay
Preserve and Maintain the State Transportation System	Pavement and bridge deficiencies; maintenance spending
Support Economic Growth	Congestion, speed, travel delay, and resources available for economic initiatives Job growth/job retention
Link Transportation and Land Use	Congestion, speed, travel delay, and improved access management
Consider Natural, Cultural, and Environmental Resources	Change in vehicle-related emissions, level of environmental certification
Enhance Safety and Security	Fatalities and serious injuries
Strengthen Partnerships	N/A – Focus on implementation policies
Promote Fiscal Stewardship	N/A – Focus on implementation policies

Linkages to Other TPM Components

Component 01: Strategic Direction (See TPM Framework)

Component 02: Target Setting

STEP 3.1.5	Document strategy identification process

Description

This step calls for documenting the strategy identification process. While this step is listed last, documentation should begin with the first step and continue throughout the process of implementing performance-based planning. The completion of this step means that an agency developing strategies has a good understanding of its current status regarding key issues or concerns surrounding their goals and respective strategies as well as its forecasting tools, economic analyses, and management systems.

The documentation step builds a record of how the strategy identification and planning process was conducted, who the stakeholders are, and why certain approaches were chosen. This reiterates the agency's overall goals for the planning process, can be rolled into a section of the LRTP, and serves as an important communications element with stakeholders. This documentation ensures that the planning and prioritization methodology will be well-defined and replicable for future plan updates. With each iteration of the LRTP, this documentation should be updated. As strategies are implemented, new understanding of their effects will come to light.

Specific topics to document include:

- Roles and responsibilities of involved staff
- Outline of business process milestones and schedule
- Process flow map
- Recommended adjustments for future target setting cycles
- Specific issues related to each implementation step

[20] Arizona Department of Transportation. (2011). What Moves You Arizona: Long-Range Transportation Plan 2010-2035, *3*. http://www.azdot.gov/docs/default-source/planning/lrtp-2011-1129.pdf?sfvrsn=2

STEP 3.1.5	Document strategy identification process

Table 3-8: Consistent and Comprehensive Documentation

Source: Federal Highway Administration

Strategy Identification Step	Topics to Document
Clarify internal and external roles and responsibilities	• Stakeholder and staff list and responsibilities • Collaboration procedures
Identify key issues or concerns	• Data source • Current performance results and issues identified in these • Baseline data
Assessment of a strategy's effect on outcomes	• Tools and methods used and why chosen • Assumptions • Future projections • Discussion and review of past strategies
Evaluating strategies	• Connection of strategies to desired outcomes/intent • Defined timeframe • How efficacy will be measured

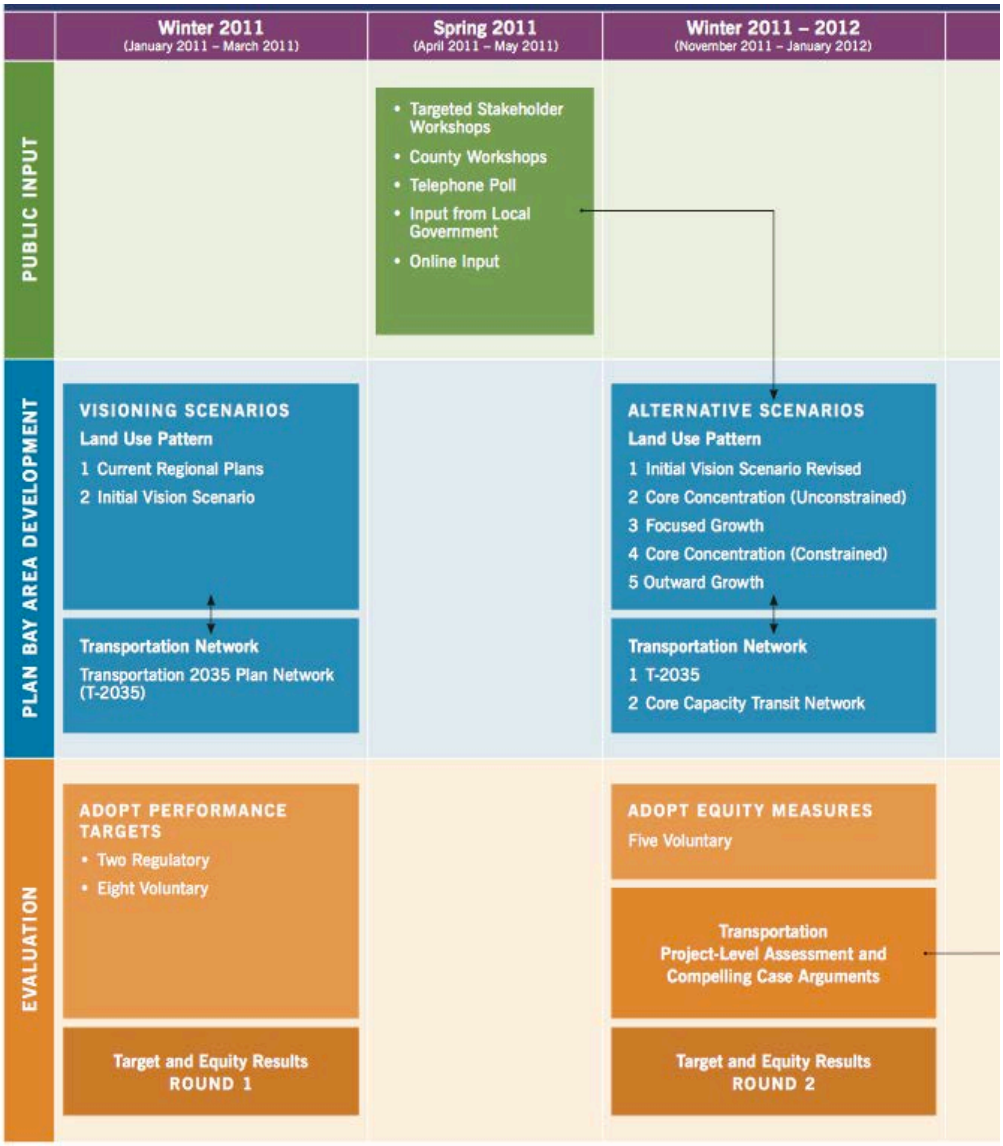
Examples

Plan Bay Area, adopted in 2013 by the Metropolitan Transportation Commission (MTC), the MPO for the San Francisco Bay Area, and the Association of Bay Area Governments (ABAG), provides an excellent documentation example. The plan spends the first several pages describing the agencies' process for collecting input from a variety of sources to develop a list of agreed-upon targets, then exploring strategies within them. It provides an extensive narration of how the plan was developed, including all of the elements listed above, as well as a graphical representation in Figure 3-9 and Figure 3-10 below. The charts display how and when information was gathered, scenarios built and tested, and those implemented measured and evaluated.

STEP 3.1.5	Document strategy identification process

Figure 3-9: Plan Bay Area Development Process

Source: Plan Bay Area[21]

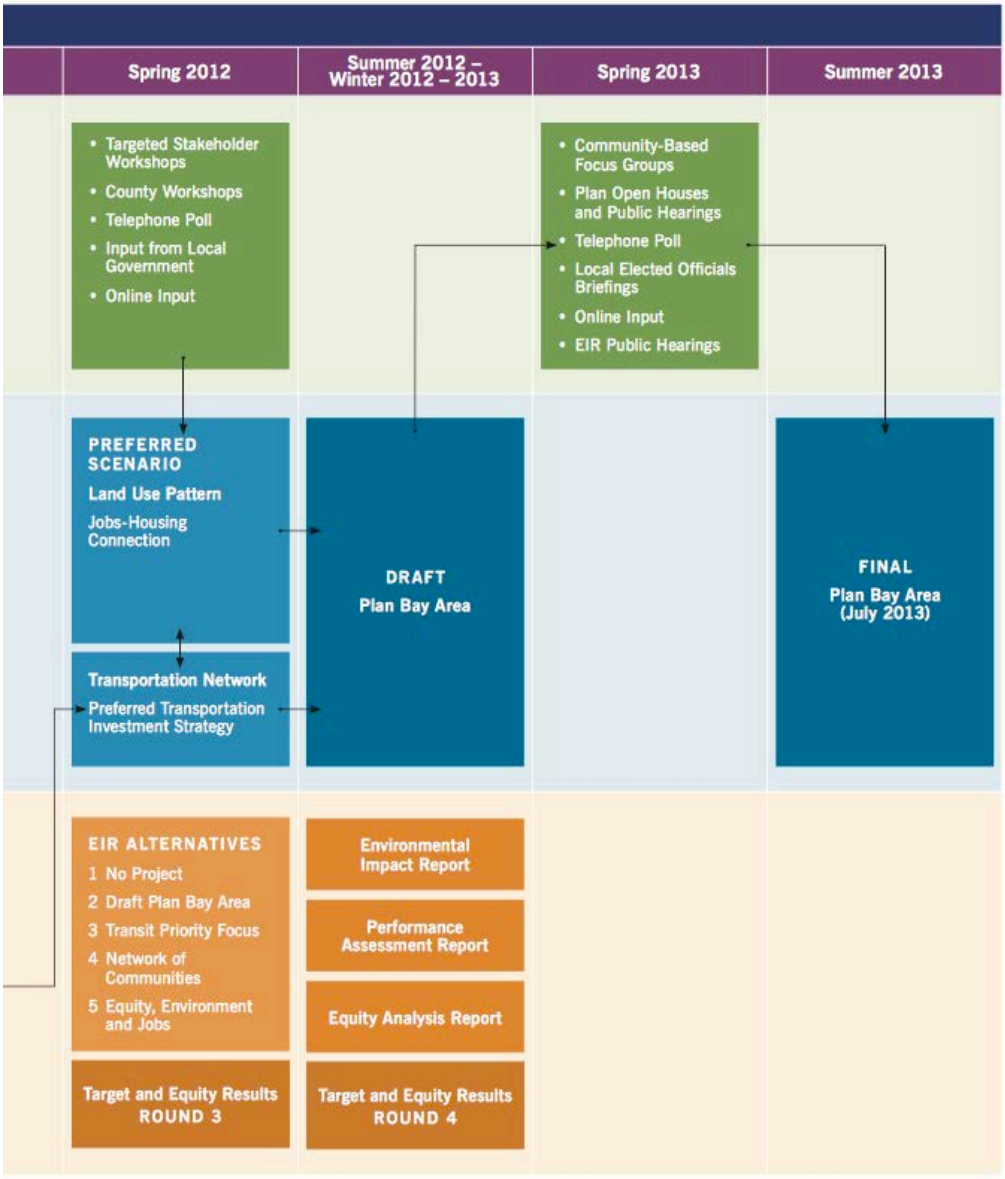


[21] Metropolitan Transportation Commission, Association of Bay Area Governments. (2013). Plan Bay Area: Strategy for a Sustainable Region, *24*. http://files.mtc.ca.gov/pdf/Plan_Bay_Area_FINAL/Plan_Bay_Area.pdf

STEP 3.1.5	Document strategy identification process

Figure 3-10: Plan Bay Area Development Process Continued

Source: Plan Bay Area[22]



Linkages to Other TPM Components	Component 01: Strategic Direction Component 04: Performance Based Programming	(See TPM Framework)

[22] Metropolitan Transportation Commission, Association of Bay Area Governments. (2013). Plan Bay Area: Strategy for a Sustainable Region, *25*. http://files.mtc.ca.gov/pdf/Plan_Bay_Area_FINAL/Plan_Bay_Area.pdf

3.2 INVESTMENT PRIORITIZATION

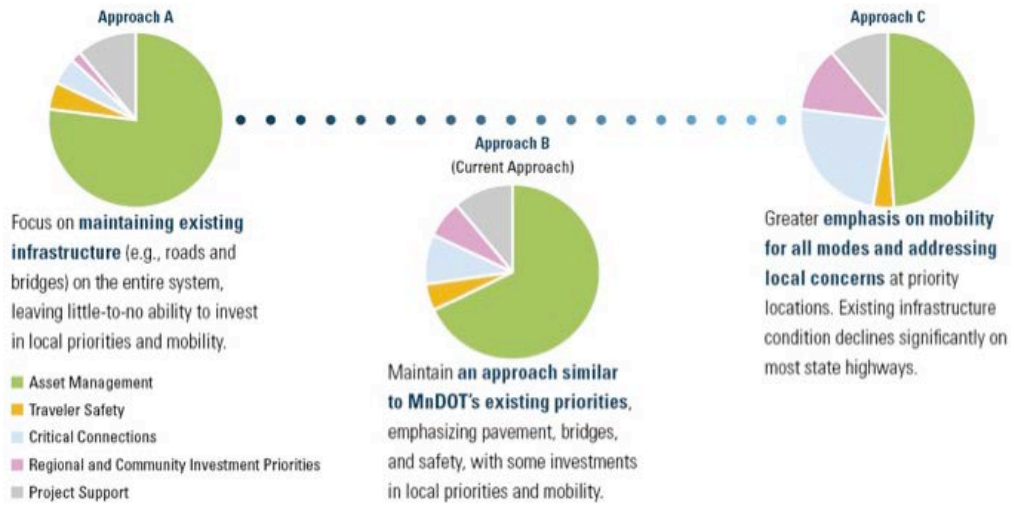
The following section outlines steps agencies can follow to prioritize and finalize the list of potential strategies that were drafted in subcomponent 3.1: Strategy Identification. Through this series of steps, an agency develops an understanding of how tradeoffs across agency performance areas are part of the prioritization process.

1. Assign internal roles and responsibilities
2. Develop scenarios to evaluate strategies
3. Establish relative importance of strategic goals to guide strategy prioritization
4. Document investment prioritization process

> "Prioritizing investments across new construction, operational improvements, and modes will promote a more cost-effective and sustainable transportation system."
>
> Source: NCHRP Report 798: The Role of Planning in a 21st Century State DOT—Supporting Decision-making

STEP 3.2.1	Assign internal roles and responsibilities
Description	This step specifies staff and designates roles and responsibilities. Staff taking part in the process of investment tradeoff and strategy prioritization should be sourced from across performance areas in order to achieve multiple goals and understand the tradeoffs between them. There should be overlap, if not congruency, between this group and those discussed in subcomponent 3.1 in order to foster coordination and consistency. The group members must have a common understanding of the strategic direction and its goals and objectives, as well as established performance measures and targets. A leadership role must be defined and understood as to who will marshal this part of the process along. It should be clear who makes final decisions and how results will be utilized toward making programming decisions.
Example	See Step 3.1.1.
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework)

STEP 3.2.2	Develop scenarios to evaluate strategies
Description	This step involves bundling strategies into groups or scenarios, understanding how performance areas rank in priority, and determining what tradeoffs are necessary to move the agency toward attainment of strategic goals as identified in Strategic Direction (Component 01). This step focuses on prioritization of performance areas, whereas the following step focuses on prioritization of goals. Staff decides what funding levels are likely and which should be evaluated. Portfolios of strategies should be evaluated together using scenario planning. Scenario planning is an analytical approach to evaluating how various combinations of strategies (scenarios) could potentially impact system performance at full scope of a performance-based plan, usually

STEP 3.2.2	Develop scenarios to evaluate strategies
	statewide.[23] Refer to FHWA's PlanWorks resource for further information about scenario planning and developing strategies.[24] This expands the comparison of goals to baseline projections to involve scenarios tested against performance outcomes rather than singular strategies. The combination of strategies within scenarios and consideration of those scenarios should be an interactive process with all stakeholders (including the public) and guides the conversation about making tradeoffs within the constraints of different funding levels. An agency's ability to assess scenarios will depend on the resources (both staff time and tools) available.
Example	**Minnesota DOT** developed three scenarios in its recent Strategic Highway Investment Plan (MnSHIP). During this stage of the planning process, MnDOT developed scenarios to understand the investments needed to meet its performance targets. The agency created a range of performance level options within each investment area. These were clearly illustrated to stakeholders in order to guide the discussion on tradeoffs required in each combination of performance levels and investment levels. **Figure 3-11: Evaluating Investment Approaches** Source: MinnesotaGO: 20-Year State Highway Investment Plan, Executive Summary[25] 

[23] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[24] FHWA. PlanWorks, LRP-7: Approve Plan Scenarios. https://fhwaapps.fhwa.dot.gov/planworks/DecisionGuide/Step/7
[25] Minnesota Department of Transportation. MinnesotaGO: 20-Year State Highway Investment Plan, Executive Summary, *ES-13*. St. Paul, MN. http://www.dot.state.mn.us/planning/mnship/pdf/executive-summary.pdf

STEP 3.2.2	Develop scenarios to evaluate strategies

Table 3-9: MnDOT Scenario Planning

Source: Federal Highway Administration

Scenario	A: Focus on maintaining existing infrastructure	B: Maintain existing approach	C: Focus on mobility for all modes and on local concerns
Pro	Improving performance regarding system preservation	Seemingly more equitable distribution of investment	More funding for mobility and local priorities
Con	Little funding left available for mobility enhancements (system expansion) and/or local priorities	Business as usual, less progress toward some performance goals	Significant deterioration of conditions on state highways

The development and discussion of these scenarios showed the public and other stakeholders what the tradeoffs were within the funding constraints. Funding levels raised in one area must naturally fall in another, revealing how meeting local demands would cause the agency to fall out of Federal guidelines in another.

The result of MnDOT's scenario planning efforts includes an updated approach on a 20-year plan, with an emphasis on risk. The plan splits priorities between two 10-year periods, rather than embrace one set of priorities for the full 20 years, acknowledging the need to respond to governmental requirements and adjust existing priorities and assumptions. This balanced approach allows MnDOT the ability to make progress in all investments in the short-term, while continuing to focus on existing infrastructure for the longer term.

Figure 3-12: MnDOT Investment Strategies in Relation to Expected Outcomes

Source: MinnesotaGO: 20-Year State Highway Investment Plan, Executive Summary[26]

Investment Category		Years 1-10 (2014-2023) Investment	Anticipated Outcome in 2023	Years 11-20 (2024-2033) Investment	Anticipated Outcome in 2033	Total 20-Year Investment
Asset Management	Pavement Condition	$2.89 billion	NHS conditions remain stable; 2% of Interstates and about 4% of other NHS routes are in Poor condition. Non-NHS condition worsens from 7-8% today to 11-12% Poor.	$5.41 billion	Interstates are at 2% Poor); other NHS and non-NHS roads are at 11-13% Poor, which is 2-3 times worse relative to today. Negative impact on freight movement, vehicles, and bicycles.	$8.30 billion
	Bridge Condition	$1.53 billion	NHS bridge conditions remain stable at 2-3% Poor. Non-NHS conditions worsen from 2% today to 4-6% Poor.	$1.89 billion	NHS bridges decline to 6-8% Poor and Non-NHS bridges decline to 8-10% Poor. Some weight restrictions and closures impact freight movement.	$3.42 billion
	Roadside Infrastructure Condition	$670 million	The condition of more culverts, signals, signs, lighting, rest areas, and retaining walls are expected to deteriorate.	$820 million	The condition of more culverts, signals, signs, lighting, and retaining walls is expected to deteriorate further. Several rest areas likely to close.	$1.49 billion

Linkages to Other TPM Components

Component 02: Target Setting (See TPM Framework)

Component 05: Monitoring and Adjustment

Component 06: Reporting and Communication

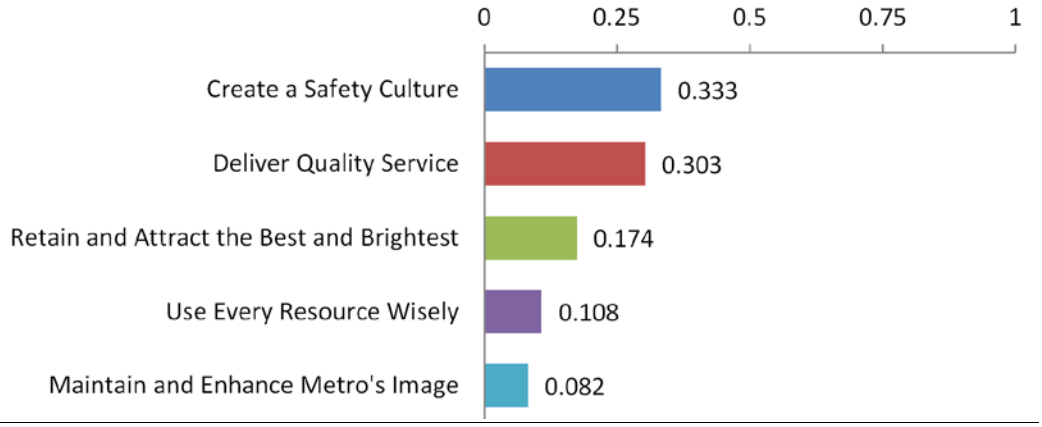
[26] Minnesota Department of Transportation. MinnesotaGO: 20-Year State Highway Investment Plan, Executive Summary, *ES-16*. St. Paul, MN. http://www.dot.state.mn.us/planning/mnship/pdf/executive-summary.pdf

STEP 3.2.3	Establish relative importance of strategic goals to guide strategy prioritization
Description	In this step, an agency develops a methodology for determining the relative priority of different goals and performance outcomes. This is necessary for the plan to provide a clear strategic direction for the agency and support decision-making. In order to do this, the tradeoff analysis developed in the scenarios above should be considered in addition to the relative need across performance areas. The most important part of this step is selection of the final strategies to be included in the long-range transportation plan or other performance-based plans, chosen from the list of strategies developed in subcomponent 3.1, and confirmed as feasible by the scenario planning in the previous step. The final list of strategies must be strongly connected back to the performance measures and goals. The list of strategies, scenarios, and measures should be reaffirmed by all stakeholders and then drafted into the final plan format.
Examples	To ensure its American Recovery and Reinvestment Act of 2009 funds would address the agency's longer-term goals, the **Washington Metropolitan Area Transit Authority** (WMATA) conducted a new agency-wide structured strategic capital planning process to select the most high-impact ready-to-go projects for stimulus funding. A strategic prioritization approach was necessary because WMATA identified $530 million in capital needs that were eligible for the $202 million ARRA funds the agency received. WMATA prioritized the $530 million list of potential projects in a process grounded in the agency's five strategic goals: create a safety culture, deliver quality service, use every resource wisely, retain and attract the best and the brightest, and maintain and enhance WMATA's image. A key step in the selection of stimulus projects was the weighting of the agency's five strategic goals. To accomplish this, the WMATA planning staff facilitated a discussion with the executive leadership team where, as a group, the executives walked through each goal, making the case for why a particular goal should be weighted higher than another. The result of the facilitated workshop was a set of weights that were later used to calculate a score for each project (Figure 3-13). The project score represented its role in achieving WMATA's strategic goals. The score calculation was based on the goal weight and how significantly each potential ARRA project contributed to each strategic objective (critical, very important, important, marginal or no contribution). The open dialogue about the goal weights not only created the structure to identify ARRA projects, but it also increased executive buy-in to the overall project selection process. In addition, WMATA was able to communicate to the Board of Directors the relationship between the selected ARRA project and its contribution to agency goals.

STEP 3.2.3	Establish relative importance of strategic goals to guide strategy prioritization

Figure 3-13: WMATA Priority Setting

Source: Federal Highway Administration[27]



Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework) Component 02: Target Setting Component 06: Reporting and Communication

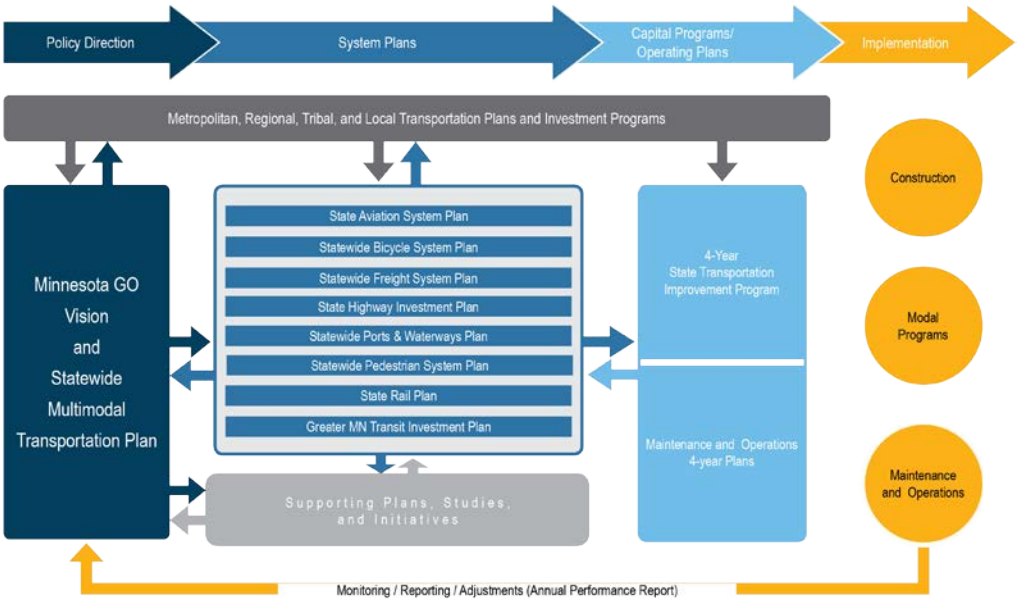
STEP 3.2.4	Document investment prioritization process
Description	This step necessitates documenting the work done to complete the steps in this subcomponent. Like the document step 3.1.5 in subcomponent 3.1, this step begins with the first step and continues throughout. Documentation created here should be included in the Long Range Transportation Plan. **Accomplishments from the above implementation steps must be documented, including:** • Defined methodologies and processes for analyzing tradeoffs and prioritizing strategies • Relationship between strategies and established goals and priorities • Staff roles and responsibilities • Data and analysis capabilities to analyze tradeoffs across alternative investment scenarios • Linkages between planning documents • How results of tradeoff analysis and strategy prioritization will be used in programming (Component 04) • How processes will be evaluated to ensure that planning documents are easy to use and are guiding decisions clearly and efficiently into the programming process
Examples	This diagram from the **Minnesota Department of Transportation** (MnDOT), included in their Minnesota GO long-range plan (http://www.dot.state.mn.us/minnesotago/index50yearvision.html), illustrates the relationships between its plans and programs. While the rest of the plan document addresses documentation of the elements listed above, this diagram is an efficient way to quickly document and display the process and flow of information involved.

[27] Illustrative example created using WMATA's strategic goals and theoretical weights.

STEP 3.2.4	Document investment prioritization process

Figure 3-14: MnDOT Plans and Programs

Source: Family of Plans[28]



At the top, the overall process leads from policy to plan to program to implementation. Beneath this, the interrelated metro, regional, and local transportation plans are interconnected, documenting how information flows from one to another and is used in input into the LRTP at left ("Minnesota GO"). From there, the information cycles to the STIP and maintenance and operations plans. Finally, at far right, the process moves into implementation steps and then completes a feedback loop via evaluation in the next iteration of the LRTP.

Linkages to Other TPM Components	Component 06: Reporting and Communication	(See TPM Framework)

[28] Minnesota Department of Transportation - Family of Plans. June 9, 2016. http://www.dot.state.mn.us/minnesotago/index50yearvision.html

RESOURCES

Resource	Year	Link
TPM Toolbox	2016	www.tpmtools.org
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning	2014	http://www.fhwa.dot.gov/planning/performance_based_planning/mlrtp_guidebook/fhwahep14046.pdf
Integrating Business Processes to Improve Travel Time Reliability	2011	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L01-RR-1.pdf
NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf
Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities	2012	http://www.fhwa.dot.gov/asset/pubs/hif12035.pdf
FHWA Scenario Planning Guidebook	2011	http://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook/
PlanWorks	2015	https://fhwaapps.fhwa.dot.gov/planworks/Home

ACTION PLAN

1. Of the TPM subcomponents discussed in this chapter, which one would you like to work on?

❑ 3.1 Strategy Identification ❑ 3.2 Investment Prioritization

2. What aspect of the TPM process listed above do you want to improve?

3. What "steps" discussed in this chapter do you think could help you address the challenge noted above?

Strategy Identification

- ❑ Clarify internal and external roles and responsibilities for effective collaboration
- ❑ Identify key performance issues for each strategic goal and objective
- ❑ Assess a strategy's effect on outcomes
- ❑ Define and evaluate strategies against desired characteristics
- ❑ Document strategy identification process

Investment Prioritization

- ❑ Assign internal roles and responsibilities
- ❑ Develop scenarios to evaluate strategies
- ❑ Establish relative importance of strategic goals to guide strategy prioritization
- ❑ Document investment prioritization process

4. To implement the "step" identified above, what actions are necessary, who will lead the effort and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success?

6. Who is someone (internal and/or external) I will collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

TABLE INDEX

U.S. Department of Transportation
Federal Highway Administration

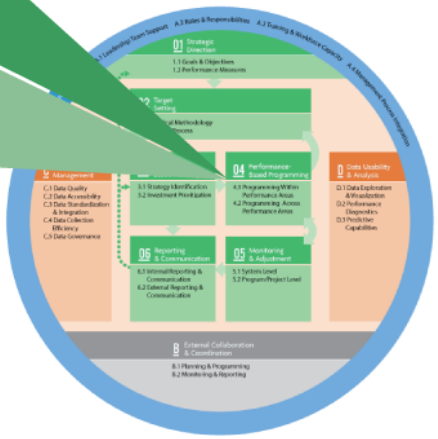
COMPONENT 4

PERFORMANCE-BASED PROGRAMMING

This chapter provides assistance to transportation agencies with the "Performance-Based Programming" component of Transportation Performance Management (TPM). It discusses where performance-based programming occurs within the TPM Framework, describes how it interrelates with the other nine components, presents definitions for associated terminology, provides links to regulatory resources, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for performance-based programming may differ from what is included in this chapter.

04 Performance-Based Programming

4.1 Programming Within Performance Areas
4.2 Programming Across Performance Areas



Performance-Based Programming uses strategies and priorities to guide the allocation of resources to projects that are selected to achieve goals, objectives, and targets. Performance-based programming establishes clear linkages between investments made and expected performance outputs and outcomes.

INTRODUCTION

Performance-based programming uses the strategies and priorities established under performance-based planning to guide the allocation of resources to projects in order to achieve strategic goals, objectives, and performance targets. Performance-based programming establishes clear linkages between investments made and their expected outputs and outcomes.

In performance-based programming, the planning strategies included in long-range transportation plans (LRTP) and other performance-based plans translate into project selection criteria. Agencies use the project selection criteria to allocate resources to specific projects and programs with the aim of achieving strategic goals, objectives, and performance targets established in the Strategic Direction (Component 01) and documented in the LRTP and other plans created during the Performance-Based Planning process (Component 03).

Completing a round of performance-based programming will result in two key products: a number of metropolitan planning organization (MPO) Transportation Improvement Program (TIP) documents and a State Transportation Improvement Program (STIP). These documents identify projects that will be funded, the timeframe for implementation, and the sources of funding that are being committed. Projects included in the STIP and TIP, when completed, should move the agency toward attainment of goals, objectives, and performance targets; these documents continue the linkage between the Strategic Direction, Target Setting, and Performance-Based Planning. To support development of the STIP and TIP, agencies can engage in scenario planning,[1] or take an analytical approach to evaluating how various combinations of strategies (scenarios) may impact system performance.[2] The STIP must incorporate projects shown in all MPO TIPs in the state, as well as transit projects. Inclusion in the STIP makes the project eligible for federal funding.[3]

A performance-based approach to programming is focused on project outcomes and how projects can push progress toward goals, objectives, and performance targets.

In this data-driven decision structure, a number of key factors should be incorporated:

- **Influencing factors** such as how the political context will affect what projects are programmed.
- **Internal collaboration** across performance areas within an agency must be evaluated. It is critical to challenge silo-based programming and budgeting and weigh and document tradeoffs between performance areas. Funding will be divided amongst preservation, expansion, and other areas; the tradeoffs should be understood, agreed upon, communicated, and documented to build and maintain support for performance-based programming.
- **External stakeholder involvement** from partner agencies, the public, and policymakers is needed to reaffirm the commitment to agency goals, objectives and performance targets.
- **Funding and resource constraints** should be considered from the outset. Since different projects qualify for different types of funding, a full menu of how monies and resources could be applied is vital to understanding the possibilities for programming considering varying constraints associated with federal and other funding programs.[4]

While performance-based planning and performance-based programming (PBPP) are often discussed as one process, there are important differences between them. This guidebook heavily references FHWA's "*Performance Based Planning and Programming Guidebook*"[5] while separating the planning and programming processes to highlight:

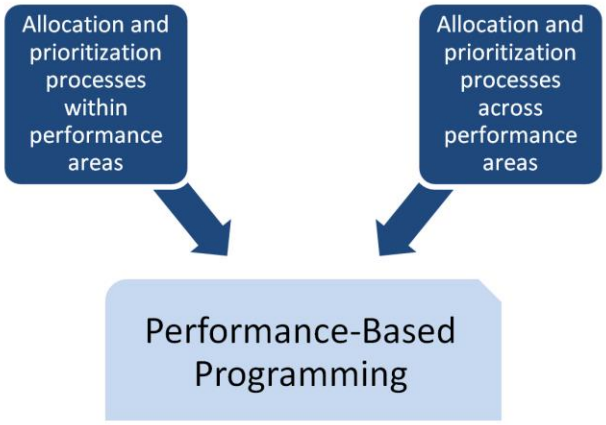
[1] FHWA. (2011). Scenario Planning Guidebook. Washington, DC. https://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook/
[2] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[3] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[4] For example, see the FTA's funding support page at http://www.fta.dot.gov/grants/12867.html
[5] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041).

1. Differences and interconnections between planning and programming processes by demonstrating the role they play in implementing TPM, and
2. How to implement a PBPP process as part of TPM.

SUBCOMPONENTS AND IMPLEMENTATION STEPS

Figure 4-1: Subcomponents for Performance-Based Programming

Source: Federal Highway Administration



The definition for performance-based programming is: the use of strategies and priorities to guide the allocation of resources to projects that are selected to achieve goals, objectives, and targets. Performance-based programming establishes clear linkages between investments made and expected performance outputs and outcomes. The performance-based programming component is comprised of two subcomponents (Figure 4-1): Programming Within Performance Areas and Programming Across Performance Areas.

- **Programming Within Performance Areas:** The allocation and prioritization processes within a performance area, such as safety, infrastructure, mobility, etc.
- **Programming Across Performance Areas:** The allocation and prioritization processes across performance areas, such as safety, infrastructure, mobility, etc.

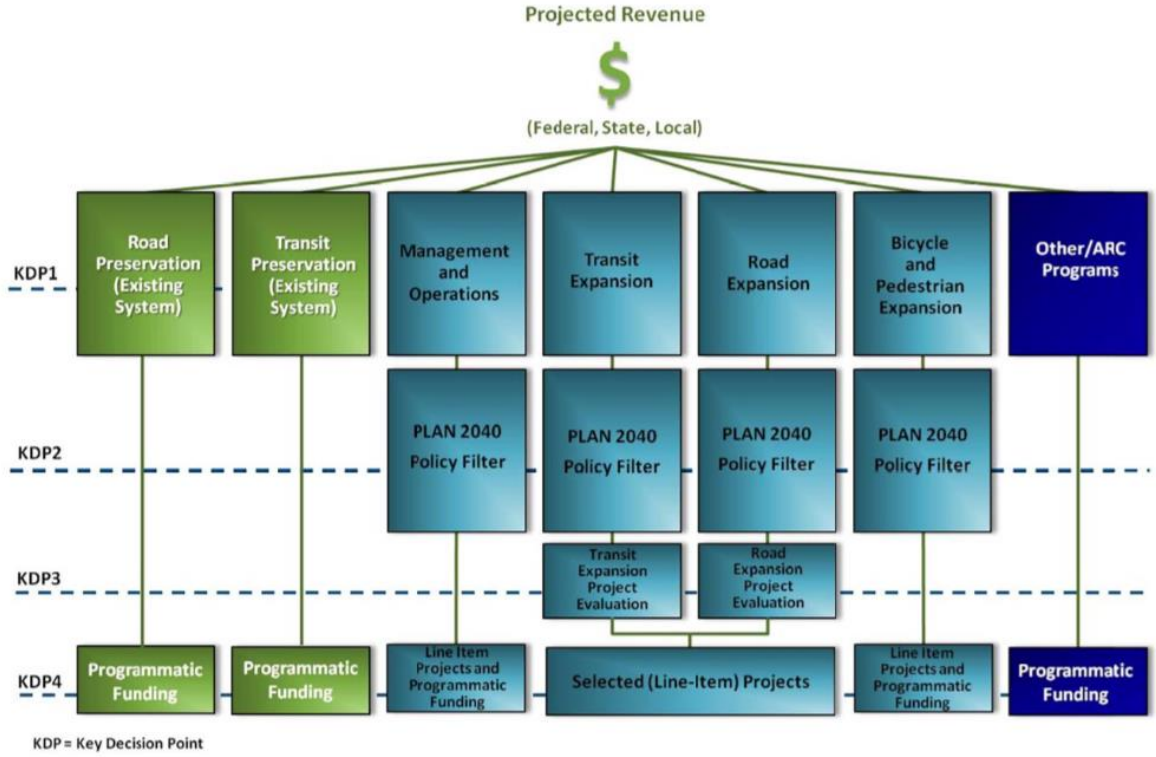
Programming Within Performance Areas

In transportation agencies, programming within performance areas is generally a more mature practice than programming across performance areas because of historical approaches to resource allocation based on legacy or a fix-it-first mentality, among others.[6] As a result, many agencies still struggle to link allocation decisions to strategic goals. Because performance measures are tied to strategic goals, agencies should develop project selection criteria based on performance measures; using these criteria (Figure 4-2) to select projects for funding will move the overall program toward supporting stated strategic goals. By screening projects using criteria that require linkage to goals, the agency has a better chance of meeting stated goals. Figure 4-2 illustrates how the Atlanta Regional Council allocates funding to various project types using criteria in performance-based plans to evaluate projects for funding (policy filters).

[6] Maggiore, M., Ford, K.M., High Street Consulting Group, & Burns & McDonnell. Transportation Research Board. (2015). *Guide To Cross-Asset Resource Allocation and the Impact on Transportation System Performance:* NCHRP Report 806. Washington, DC. Retrieved from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

Figure 4-2: Atlanta Regional Commission Programming Process

Source: Atlanta Regional Commission PLAN 2040[7]



Therefore, project selection criteria become a critical piece of the programming process. Some agencies use a quantitative scoring approach while others use this only as a first step, adding an additional screening for project feasibility, funding availability, and project timing. Other agencies may rely heavily on economic analyses within program areas such as bridge or pavement to prioritize projects to minimize lifecycle costs.

Once projects are selected and programmed, the agency then monitors projects to determine how well projects contributed to attaining targets and meeting goals. That information is then used to adjust future planning and programming cycles to continually improve performance (see Monitoring and Adjustment, Component 05).

Programming Across Performance Areas

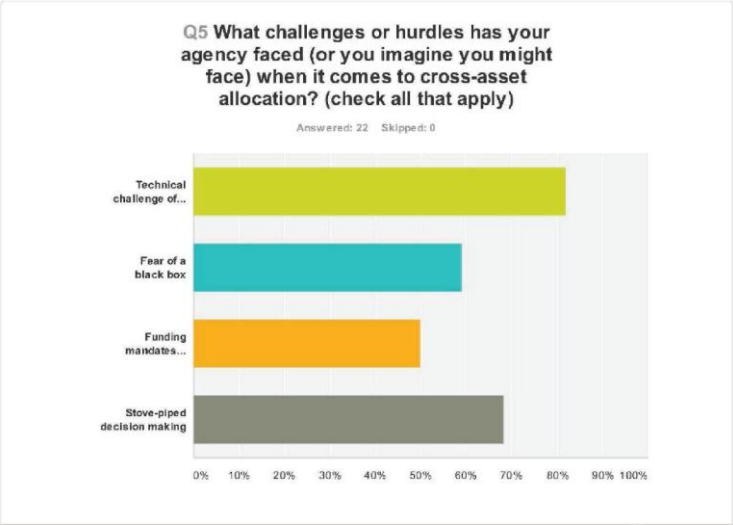
Cross-performance area programming is still an emerging process as illustrated by research and the state of the practice review conducted under NCHRP 806 Report, "*Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance.*"[8] Figure 4-3 makes clear how challenging agencies perceive cross-asset allocation to be.

[7] Atlanta Regional Council. (2014). Atlanta Regional Transportation Plan. Atlanta, GA.

[8] Maggiore, M., Ford, K.M., High Street Consulting Group, & Burns & McDonnell. Transportation Research Board. (2015). *Guide To Cross-Asset Resource Allocation and the Impact on Transportation System Performance:* NCHRP Report 806. Washington, DC. Retrieved from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

Figure 4-3: Workshop Survey Response, Question 5

Source: Guide to Cross-Asset Resource Allocation [9]



A number of agencies are developing cross-performance area approaches to prioritization, or are already prioritizing, across performance areas. These agencies are highlighted throughout illustrative examples for each implementation step later in the chapter.

While cross performance area programming approaches vary, it generally includes the following pieces:[10]

- **Project scoring** using project selection criteria that link projects to goals
- **Prioritizing based on value** of project per dollar spent
- **Optimizing** to select projects based on budget constraints
- **Trade-off analysis** to determine the impacts on all performance areas of a particular allocation scenario

Agencies have determined varying ways to score projects, but often projects are categorized into a relatively few number of categories so that projects can be appropriately compared. Each category can weigh goal areas differently, to ensure projects of a particular type are not penalized for weak linkage to a goal that is not relevant. For example, a project category devoted to capacity expansion projects would be expected to have no linkage to system preservation; in this case, the weight for the system preservation goal area would be low relative to other goals. Project selection criteria are then developed to evaluate projects' value and contribution toward strategic goals. The output of this process is a prioritized list of projects based on goal linkage.

Further prioritization steps are then taken including those based on benefit/cost and budget constraints. With an unlimited budget, performance would theoretically be very high in all performance areas; however, budgets are indeed constrained and this requires an analysis of trade-offs.

Assessing trade-offs between investment scenarios (i.e., scenario planning[11]) is a key element of cross performance area prioritization. The agency must choose which goal areas are most significant and allocate resources to those

> "It should be noted that that ability of transportation agencies to implement a fully flexible, discretionary approach to resource allocation varies across the country due to unique institutional, organization, and political situations."
>
> Source: NCHRP Report 806, Cross-Asset Resource Allocation

[9] Maggiore, M., Ford, K.M., High Street Consulting Group, & Burns & McDonnell. Transportation Research Board. (2015). *Guide To Cross-Asset Resource Allocation and the Impact on Transportation System Performance:* NCHRP Report 806. Washington, DC. Retrieved from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

[10] Maggiore, M., Ford, K.M., High Street Consulting Group, & Burns & McDonnell. Transportation Research Board. (2015). *Guide To Cross-Asset Resource Allocation and the Impact on Transportation System Performance:* NCHRP Report 806. Washington, DC. Retrieved from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

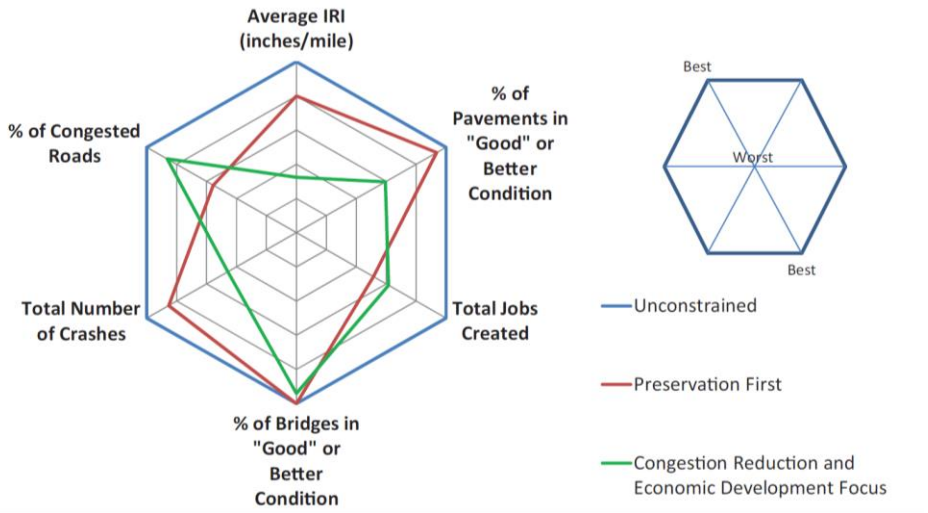
[11] Federal Highway Administration. (2011). Scenario Planning Guidebook. http://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook/guidebook.pdf

areas to achieve desired performance levels, while remaining funding is allocated elsewhere. However, performance cannot fall too low in the less critical goal areas, so trade-off analysis is essential to preventing this situation. Because overall resources are limited, focusing resources in particular areas (such as pavement condition, or congestion reduction) drives greater benefits in focused areas compared to other areas.

Figure 4-4 the effect of goal area prioritization and budget constraints. The blue line represents an unconstrained scenario where all needs are fully funded, and desired performance can be maintained in all goal areas. The red and green lines represent two constrained scenarios. If an agency focuses on preservation first (red line), the diagram demonstrates how pavement and bridge condition improve (red line extends out to these goal areas), while the percentage of congested roads may increase. In the congestion reduction and economic development scenario (green line), congestion decreases but pavement condition and International Roughness Index (IRI) decreases.[12] Trade-off analysis provides an opportunity for executives, staff, stakeholders, and users to discuss what truly matters.[13] Using visual aids like the one below can assist such a discussion.

Figure 4-4: Impact on Performance Outcomes by Goal Area Prioritization

Source: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance [14]



Challenges to this process abound. Many transportation agencies allocate resources based on legacy, with previous funding allocation determining future allocation. Other transportation agencies operate with a fix-it first mentality, leaving only limited funding to be prioritized. Major barriers to implementing improved approaches include a weak strategic direction; agencies do not prioritize goal areas. As discussed above, this is critical. Other barriers include lack of data and forecasting tools, institutional resistance to changing allocation processes, as well as resistance by partners, and political resistance from decision makers who feel their authority threatened.[15]

Despite these challenges, agencies have begun to program across performance areas and are highlighted in the implementation steps for subcomponent 4.1. While both sets of implementation steps will assist an agency in

[12] Maggiore, M., Ford, K.M., High Street Consulting Group, & Burns & McDonnell. Transportation Research Board. (2015). *Guide To Cross-Asset Resource Allocation and the Impact on Transportation System Performance:* NCHRP Report 806. Washington, DC. Retrieved from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

[13] Maggiore, M., Ford, K.M., High Street Consulting Group, & Burns & McDonnell. Transportation Research Board. (2015). *Guide To Cross-Asset Resource Allocation and the Impact on Transportation System Performance:* NCHRP Report 806. Washington, DC. Retrieved from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

[14] Maggiore, M., Ford, K.M., High Street Consulting Group, & Burns & McDonnell. Transportation Research Board. (2015). *Guide To Cross-Asset Resource Allocation and the Impact on Transportation System Performance:* NCHRP Report 806. Washington, DC. Retrieved from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

[15] Maggiore, M., Ford, K.M., High Street Consulting Group, & Burns & McDonnell. Transportation Research Board. (2015). *Guide To Cross-Asset Resource Allocation and the Impact on Transportation System Performance:* NCHRP Report 806. Washington, DC. Retrieved from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf

performance-based programming, the steps differ because of the important differences between programming within and across performance areas. However, it is important to note that both within and across performance area, programming efforts rely on project selection criteria and the purpose of both efforts is STIP and TIP development.

Table 4-1: Performance-Based Programming Implementation Steps

Source: Federal Highway Administration

Programming Within Performance Areas	Programming Across Performance Areas
1. Clarify roles of internal staff and external stakeholders	1. Identify and assign internal roles and responsibilities
2. Develop project selection criteria	2. Clarify purpose of cross performance area prioritization
3. Establish a formal input process to gather performance-based project information	3. Develop a methodology that reflects agency priorities and external stakeholder interests
4. Document the process	4. Document the process

As illustrated in Table 4-1, programming takes the prioritized projects developed in the planning stage and links them to funding. Most importantly, programming demonstrates how funding can be most effectively utilized to improve performance or achieve targets. Using these steps allows an agency to implement the process based on performance goals, first within performance areas and building builds additional understanding of tradeoffs across performance areas.

CLARIFYING TERMINOLOGY

Table 4-2 presents the definitions for the performance-based programming terms used in this Guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table 4-2: Performance-Based Programming: Defining Common TPM Terminology

Source: Federal Highway Administration

Common Terms	Definition	Example
Goal	A broad statement of a desired end condition or outcome; a unique piece of the agency's vision.	A safe transportation system.
Objective	A specific, measurable statement that supports achievement of a goal.	Reduce the number of motor vehicle fatalities.
Performance Measure	Performances measures are based on a metric that is used to track progress toward goals, objectives, and achievement of established targets. They should be manageable, sustainable, and based on collaboration with partners. Measures provide an effective basis for evaluating strategies for performance improvement.	Transit passenger trips per revenue hour.
Program	A program is a document which matches funding to projects.	A State Transportation Improvement Program (STIP).
Project Selection Criteria	Evaluation metrics used to rank projects.	Numerical weights assigned to goals such as economic impact or environmental effects.

Common Terms	Definition	Example
Scenario	Scenarios use funding and performance data to determine likely future outcomes.	An investment of five % more revenue may reduce SD bridges by 10%.
Scenario Planning	A technique designed to help citizens and stakeholders understand how changes in various forces potentially impact transportation networks in an area.[16]	Engaging the public in a workshop to compare and contrast the impact of land use scenarios on traffic volumes and distribution.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.

RELATIONSHIP TO TPM COMPONENTS

The ten TPM components are interconnected and often interdependent. Table 4-3 summarizes how each of the nine other components relate to the performance-based programming component

Table 4-3: Performance-Based Programming Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to Performance-Based Programming
01. Strategic Direction	The establishment of an agency's focus through well-defined goals/objectives and a set of aligned performance measures.	Programmed projects are linked directly to the strategic direction since they are prioritized by their potential ability to address goals and objectives.
02. Target Setting	The use of baseline data, information on possible strategies, resource constraints and forecasting tools to collaboratively establish targets.	Programmed projects are selected and funded based on how they help achieve performance targets.
03. Performance-Based Planning	Use of a strategic direction to drive development and documentation of agency strategies and priorities in the long-range transportation plan and other plans.	Performance-based programming allocates funding to projects identified as part of the strategies developed and documented in performance-based plans.
05. Monitoring and Adjustment	Processes to track and evaluate actions taken and outcomes achieved that establish a feedback loop to adjust planning, programming, and target setting decisions. Provides key insight into the efficacy of investments.	Completed projects from the STIP and TIP should be assessed to determine whether they provided the expected progress toward performance targets.
06. Reporting and Communication	Products, techniques and processes to communicate performance information to different audiences for maximum impact.	The programming process must be transparent and well communicated to ensure support and understanding of prioritization framework by stakeholders.

[16] FHWA. (2011). Scenario Planning Guidebook. http://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook/

Component	Summary Definition	Relationship to Performance-Based Programming
A. TPM Organization and Culture	Institutionalization of a TPM culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support TPM.	The link between programming and performance must be supported by and understood by leadership and agency-wide to comprehensively implement the process.
B. External Collaboration and Coordination	Established processes to collaborate and coordinate with agency partners and stakeholders on planning/ visioning, target setting, programming, data sharing, and reporting.	The programming process must be clearly communicated to external stakeholders and coordinated with partner agencies. For example, a State DOT's STIP and an MPO's TIP must align.
C. Data Management	Established processes to ensure data quality and accessibility, and to maximize efficiency of data acquisition and integration for TPM.	Programming relies on data managed from various sources, including those from partner agencies.
D. Data Usability and Analysis	Existence of useful and valuable data sets and analysis capabilities, provided in usable, convenient forms to support TPM.	The programming process is based on good analysis of scenarios derived from an understanding of funding and baseline data projected forward into the future.

REGULATORY RESOURCES

This Guidebook is intended to assist agencies with implementing transportation performance management in a general sense and not to provide guidance on compliance and fulfillment of Federal regulations. However, it is important to consider legislative requirements and regulations when using the Guidebook. In many cases, use of this Guidebook will bring an agency in alignment with Federal requirements; however, the following sources should be considered the authority on such requirements:

Federal Highway Administration

- Transportation Performance Management: http://www.fhwa.dot.gov/tpm/links_fhwa.cfm
- Fact Sheets on Fixing America's Surface Transportation (FAST) Act: https://www.fhwa.dot.gov/fastact/factsheets/
- Fact Sheets on Moving Ahead for Progress in the 21st Century (MAP-21): https://www.fhwa.dot.gov/map21/factsheets/
- Resources on MAP-21 Rulemaking: https://www.fhwa.dot.gov/tpm/rule.cfm

Federal Transit Administration

- Fact Sheets on FAST Act: https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-fast-act
- Resources on MAP-21: https://www.transit.dot.gov/regulations-and-guidance/legislation/map-21/map-21-program-fact-sheets

IMPLEMENTATION STEPS

4.1 PROGRAMMING WITHIN PERFORMANCE AREAS

One facet of Performance-Based Programming is the resource allocation and prioritization processes *within* a performance area, such as safety, infrastructure, or mobility. The following section outlines steps agencies can follow in order to develop a program that is based on performance targets and which supports organizational goals and objectives.

1. Clarify roles of internal staff and external stakeholders
2. Develop project selection criteria
3. Establish a formal input process to gather performance-based project information
4. Document the process

> "Performance information is never intended to make the decisions; rather this information is intended to inform the decision makers so the process is more focused on performance outcomes."
>
> - David Lee, Florida DOT

STEP 4.1.1	Clarify roles of internal staff and external stakeholders
Description	This step defines who is involved in the process, and when and how it will happen. A timeline for the programming process should be outlined, including when input is needed from partner agencies and other stakeholders. Goals, objectives, targets, and performance measures should be reviewed with stakeholders and strongly leveraged by senior management to ensure all involved have an understanding of these guiding elements that shape the program. Individuals should also be very familiar with the performance-based plans developed in the Performance-Based Planning process (Component 03), which build from goals, objectives, and targets to shape the programming of projects. Discussion with partner agencies should also confirm regional priorities.
Examples	**Arizona Department of Transportation (ADOT)** has established their P2P initiative to link planning to programming within the agency. **This program is aimed to:**[17] • Develop a transparent, defensible, logical, reproducible process for programming improvements • Link planning to programming to use funds more effectively • Drive investment decision-making with system performance • Simplify program structure • Implement a risk-based approach • Assist with MAP-21 implementation This approach is reflected in ADOT's organization of the process in its timeline and staff and stakeholder role outline. The agency demonstrates the alignment of who, what, and when in the agency's annual program update, as seen below. The spiral schedule gives a month-by-month representation of what group is working on which piece of the process. For example,

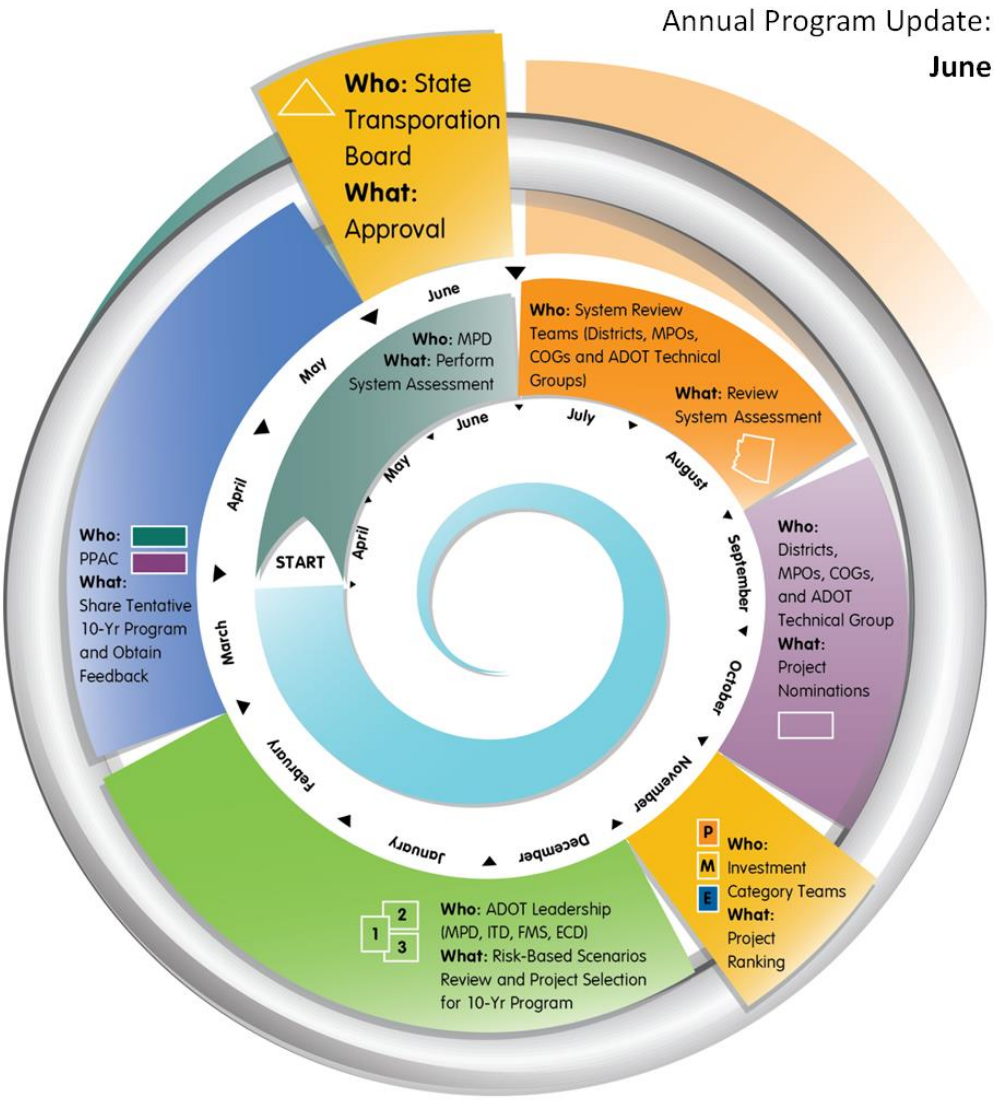
[17] Arizona DOT. *Linking Planning and Programming: New Direction for Investment Decisions*. Presentation April 17, 2014. http://azdot.gov/docs/default-source/planning/p2p-r-s-(04-17-14).pdf?sfvrsn=2

STEP 4.1.1	Clarify roles of internal staff and external stakeholders

the month pictured below is the final one of the process timeline, and highlights that at this time the State Transportation Board will be working toward approval of the program. As the final month, it also displays "the who, what, and when" for the preceding months of the full three-year update agenda. This has assisted ADOT in keeping all the pieces aligned, as the agency works on new MAP-21 required plans while also updating the LRTP and drawing on this to build the updated 10-year program.

Figure 4-5: AZDOT P2P Initiative Process

Source: Linking Planning and Programming: New Direction for Investment Decisions[18]



Whether presented in a more complex graphical format, as ADOT has done, or having an assignment list and timeline simply laid out as a reference will be vital to guide the process.

[18] Arizona DOT. *Linking Planning and Programming: New Direction for Investment Decisions*. Presentation April 17, 2014. Phoenix, AZ. http://azdot.gov/docs/default-source/planning/p2p-r-s-(04-17-14).pdf?sfvrsn=2

STEP 4.1.1	Clarify roles of internal staff and external stakeholders
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework) Component 01: Strategic Direction Component 06: Reporting and Communication

STEP 4.1.2	Develop project selection criteria
Description	Criteria based on agency goals and objectives must be established to guide project selection. This must be understood and supported broadly by stakeholders and be reflective of regional priorities. In addition, the specific sources for the criteria must be reviewed and discussed together, so that criteria reflect priorities in all planning documents. These source documents include the MPO LRTP, state LRTP, asset management plans, transit development plans, local government plans, freight plans, and others. Within these documents there may also be a discussion of risks that should be extrapolated from the priority level within the plans to the project-specific level for the program. As discussed in Performance-Based Planning (Component 03), risk is the positive or negative impact of uncertainty on a process or project. Risks may be positive or negative and generally can be defined as hazard, financial, operational, or strategic risks.[19] Since all risks have financial implications, these must be understood as a variable when considering outcomes based on funding scenarios. As an example, Washington State provides a series of guidelines as to how to incorporate risk into project planning and programming with its Project Risk Management Guide: http://www.wsdot.wa.gov/publications/fulltext/cevp/ProjectRiskManagement.pdf. This guide established a comprehensive process for incorporating risk management into agency processes, including certain requirements to be met depending on project size. A Risk Management program helps agencies expect the unexpected and anticipate additional costs or shifting project budgets as accurately as possible.
Examples	The **Pikes Peak Area Council of Governments (PPACG)**, the MPO for the Colorado Springs, Colorado region, developed a clear set of criteria in its *Moving Forward Update 2035*, featured as one of FHWA's case studies in its *A Guide for Incorporating Performance-Based Planning* (2014). PPACG established a set of evaluation criteria based on its goals and objectives to assess all projects under consideration. The agency assigned one evaluation criterion for each goal, which resulted in a large number of criteria. This is a common situation in any process seeking to gather criteria from a large array of sources and stakeholders. In order to properly align the criteria, PPACG created a weighting system to reflect and credit the relative importance of each criterion for the transportation system. A ranking exercise with the Transportation and the Community Advisory Committees and a phone survey from the public resulted in an

[19] Definitions summarized from *NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance,* page 20.

STEP 4.1.2	Develop project selection criteria

average ranking for each criterion that was adopted by the MPO Board. The result was that PPACG was able to maintain all 17 of the criteria matched to 17 goals, while also very clearly ranking those goals, making the tradeoff process much more straightforward.

Table 4-4: PPACG Example of Evaluation Criteria

Source: Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning (2014)[20]

Goal	Evaluation Criteria	E.C. Weight Value (Rank)
1. Maintain or improve current transportation system infrastructure	Transportation System Condition Preservation and Rehabilitation	9.5 (1)

Linkages to Other TPM Components

Component A: Organization and Culture (See TPM Framework)

Component 03: Performance-Based Planning

STEP 4.1.3	Establish a formal input process to gather performance-based project information

Description

This step allows specific projects to be assessed relative to the criteria developed in the previous step. Gathering this information enables the agency to track the anticipated effects of projects after their completion, and thus evaluate their impact on the attainment of performance targets and goals. This will provide an answer as to how investments in specific projects also lead toward those targets and goals, enabling an agency to track the flow of money and the efficacy of its impacts. This means that after project completion, the agency will be able to further justify or reexamine the allocation of monies and how programming decisions were made. The input process will build a simple database of project characteristics such as location, start/stop dates, owner, justification, and project description and outcome.

Examples

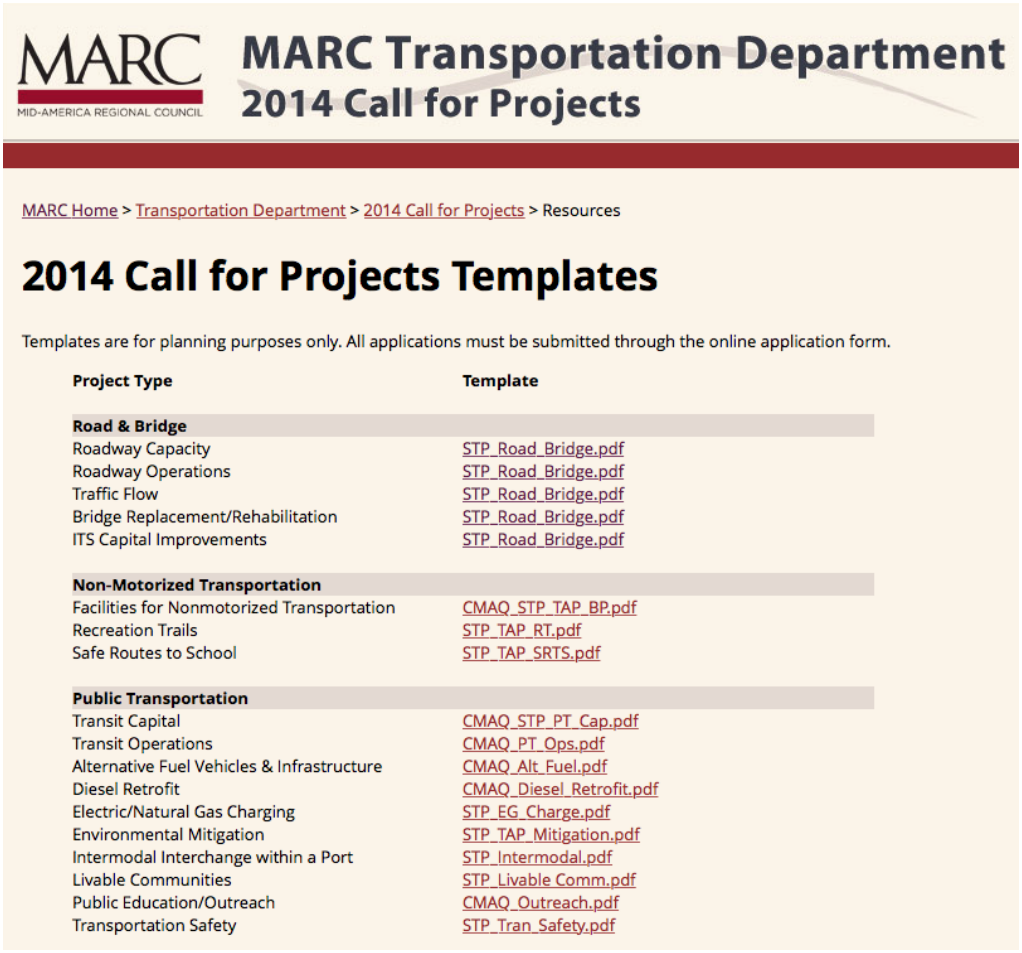
At the **Mid-America Regional Council (MARC)**, the metropolitan planning organization (MPO) for the greater Kansas City area, an online template library was developed to gather calls for projects for programming efforts.

[20] Federal Highway Administration. (2014). Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning. Washington, DC. http://www.fhwa.dot.gov/planning/performance_based_planning/mlrtp_guidebook/fhwahep14046.pdf

STEP 4.1.3	Establish a formal input process to gather performance-based project information

Figure 4-6: MARC Project Templates

Source: MARC Transportation Department[21]



MARC
MID-AMERICA REGIONAL COUNCIL

MARC Transportation Department
2014 Call for Projects

MARC Home > Transportation Department > 2014 Call for Projects > Resources

2014 Call for Projects Templates

Templates are for planning purposes only. All applications must be submitted through the online application form.

Project Type	Template
Road & Bridge	
Roadway Capacity	STP_Road_Bridge.pdf
Roadway Operations	STP_Road_Bridge.pdf
Traffic Flow	STP_Road_Bridge.pdf
Bridge Replacement/Rehabilitation	STP_Road_Bridge.pdf
ITS Capital Improvements	STP_Road_Bridge.pdf
Non-Motorized Transportation	
Facilities for Nonmotorized Transportation	CMAQ_STP_TAP_BP.pdf
Recreation Trails	STP_TAP_RT.pdf
Safe Routes to School	STP_TAP_SRTS.pdf
Public Transportation	
Transit Capital	CMAQ_STP_PT_Cap.pdf
Transit Operations	CMAQ_PT_Ops.pdf
Alternative Fuel Vehicles & Infrastructure	CMAQ_Alt_Fuel.pdf
Diesel Retrofit	CMAQ_Diesel_Retrofit.pdf
Electric/Natural Gas Charging	STP_EG_Charge.pdf
Environmental Mitigation	STP_TAP_Mitigation.pdf
Intermodal Interchange within a Port	STP_Intermodal.pdf
Livable Communities	STP_Livable Comm.pdf
Public Education/Outreach	CMAQ_Outreach.pdf
Transportation Safety	STP_Tran_Safety.pdf

The *Transportation Outlook 2040* LRTP and accompanying TIP included both fiscally constrained and unconstrained project lists, demonstrating how a large number of projects can be narrowed down using a strong set of criteria to match projects with prioritized goal areas, and then constrain them within the range of available funding. The online call for projects page is currently in use for multiple plans, including MARC's Surface Transportation Program, 2017-2018, Transportation Alternatives (TAP), 2014-2018, and Congestion Mitigation and Air Quality Improvement Program 2015-2018.

The input uses a menu to gather basic information on the project such as program, location, need, modes, description, usage, and relationship to or inclusion in a number of other plans. This allows MARC to receive a large amount of information from a large number of users while simultaneously organizing it into a database-friendly format that will assist in building a prioritized project list. For more, see http://www.marc2.org/tr-call/index.aspx and http://www.marc2.org/tr-call/templates.aspx.

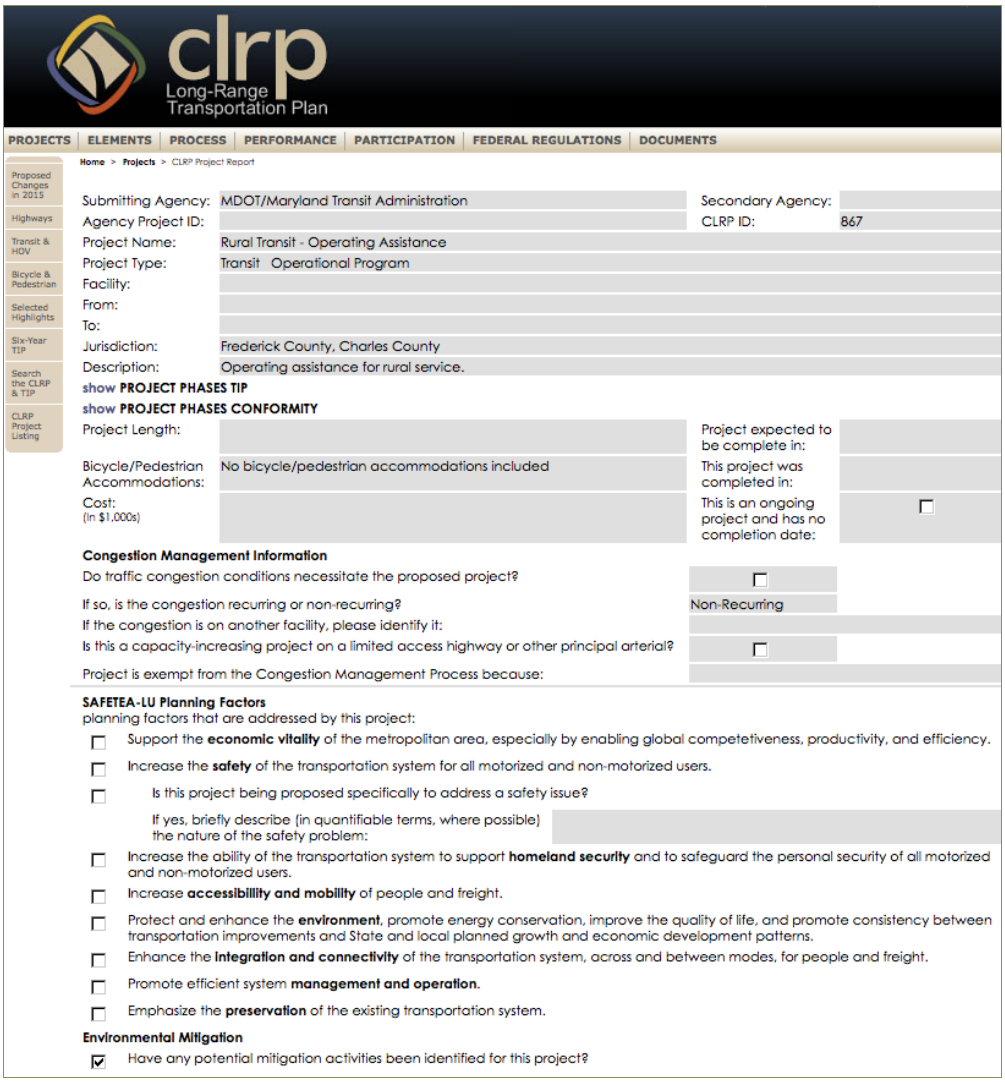
[21] Mid-American Regional Council Transportation Department. (2014). Kansas City, MO.

STEP 4.1.3	Establish a formal input process to gather performance-based project information

The **National Capital Region Transportation Planning Board** has a similar online interface that allows project input. In this example, the Maryland Transit Administration (within the Maryland Department of Transportation (MDOT)) has submitted a project report for Rural Transit Operating Assistance.

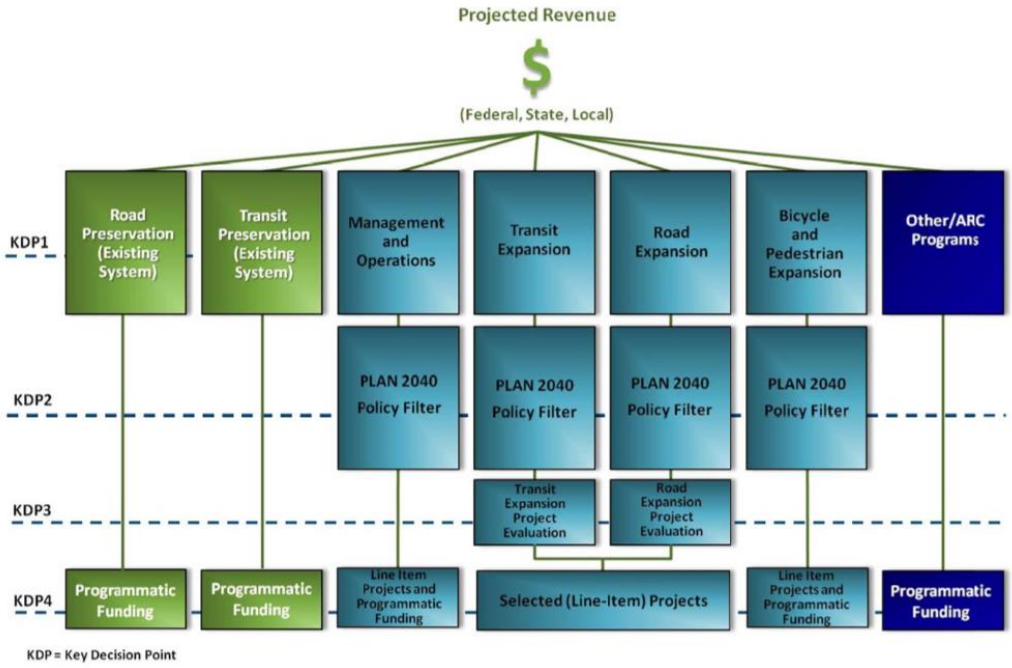
Figure 4-7: CLRP Online Interface

Source: CLRP: Long Range Transportation Plan[22]



Linkages to Other TPM Components		
	Component A: Organization and Culture	(See TPM Framework)
	Component 01: Strategic Direction	
	Component 06: Reporting and Communication	
	Component B: External Collaboration and Coordination	

[22] CLRP: Long Range Transportation Plan. June 9, 2016. http://www.mwcog.org/clrp/

STEP 4.1.4	Document the process
Description	The performance-based programming process must be documented in a manner that ensures transparency and accountability and makes clear how and why projects were chosen for the program. This is one of the major tenets of TPM: ensuring that decisions are based on performance outcomes and making this clear throughout the process. This strengthens the key link back to goals, objectives, and targets. This documentation becomes a vital part of the STIP or TIP. In addition to documenting the process for arriving at that document, further narrative should be included about how the agency will continue to refine the methodology for programming moving forward and how the efficacy of investments will be evaluated. This documentation is vital not only for inclusion in the final programming document, but also for use in Monitoring and Adjustment (Component 05), which evaluates the efficacy of the overall process of allocating resources toward achieving strategic goals; and Reporting and Communication (Component 06), which enhances internal external understanding of performance results.
Examples	**Figure 4-8: Atlanta Regional Commission Plan 2040 Funding Allocation** Source: Atlanta Regional Commission PLAN 2040[23]  The Atlanta Regional Commission (ARC) provides an illustration of documenting the programming process in this figure on project selection from its PLAN 2040 Regional Transportation Plan. This figure illustrates where and how funding is allocated. It provides a quick reference to key decision points (KDP) where input is needed to shape project selection. It also can be a sort of menu, showing the many areas in need of funding that must be

[23] Atlanta Regional Council. (2014). Atlanta Regional Transportation Plan. Atlanta, GA.

STEP 4.1.4	Document the process
	balanced. The first row represents the general program area and colors indicate performance areas, with system preservation in green, congestion/mobility in blue, and other in dark blue. Projects are then divided into the appropriate plans and programs with increasing detail, leading to KDP 4 where the program is finalized for each project type. For more, visit the Plan 2040 site at http://www.atlantaregional.com/transportation/regional-transportation-plan/rtp-chapters-and-appendices.
Linkages to Other TPM Components	Component 05: Monitoring and Adjustment (See TPM Framework) Component 06: Reporting and Communication

4.2 PROGRAMMING ACROSS PERFORMANCE AREAS

Performance-Based Programming also addresses allocation and prioritization processes across performance areas. As discussed in the Introduction, though this is an emerging practice, some agencies have well-developed frameworks for this process. Implementation steps are:

1. Identify and assign internal roles and responsibilities
2. Clarify purpose of cross performance area prioritization
3. Develop a methodology that reflects agency priorities and external stakeholder interests
4. Document the process

> "The ability to apply the framework…depends on an agency's organization structure and maturity with respect to performance-based planning, asset management, needs identification, and performance management."
>
> Source: NCHRP Report 806, Cross-Asset Resource Allocation

Although not specified as a step, Programming Across Performance Areas requires development of project selection criteria similar to Programming Within Performance Areas (refer to step 4.1.2 "Develop project selection criteria").

STEP 4.2.1	Identify and assign internal roles and responsibilities
Description	Because across performance area programming is not yet common practice, it is critical for the agency to clearly define roles and responsibilities for completing the process. Adjustments to the way programming has previously been done will likely encounter resistance for a number of reasons, including worries over the potential for reduced allocations on the part of particular performance area staff, concern over increased workloads due to project submission and scoring, and skepticism about the assessment tool/methodology to be employed. These are all valid concerns, and should be addressed openly from the beginning to ensure support among staff. To establish a process that will be used on a continuing basis to drive investments, staff must feel that the new way of doing things is useful, worth any extra work required, is responsive to their input, and respects existing processes. It is also important that senior managers and executives express support for this initiative. While establishing an inclusive process will bring some staff on board, some will remain resistant. Executive support will ensure this group continues to support the effort even while they are not convinced of its merits. **Roles to define include:** • Project curator – who will facilitate project submissions? • Criteria selection team – who will develop criteria by which projects will be evaluated for inclusion in the STIP or TIP? • Data reporters – who is responsible for reporting data that will be used to assess projects? • Analysts—who will evaluate the potential projects based on the criteria? Determination of what methodology will be used? • Decision maker—who will finalize and approve the selection of projects? • Liaison – who will communicate progress to the agency as a whole and gather feedback from those not intimately involved in process development?

STEP 4.2.1	Identify and assign internal roles and responsibilities

Examples

House Bill 2 in Virginia directs the Commonwealth to establish an objective process to score projects for funding to ensure that the budget allocation process is transparent to the public and that the most strategic projects are chosen. The Commonwealth Transportation Board (CTB) is an 18-member group including district representatives, the Secretary of Transportation, the Director of the Department of Rail and Public Transportation, and the Director of the Department of Transportation. The CTB allocates funding to specific projects for all transportation projects in the state; because of HB2, the Board will now use an objective project scoring system to program projects.

The HB2 Implementation Policy Guide[24] documents eligible projects and the scoring process; it also defines roles and responsibilities:

Table 4-5: HB2 Implementation and Responsibilities

Source: HB2 Implementation Policy Guide[25]

Group	Roles and Responsibilities
Commonwealth Transportation Board	• Oversees project evaluation process • Uses the project evaluations to inform funding decisions • Not required to fund highest-scoring projects, but must be able to justify decisions if not consistent with evaluation scoring
Office of the Secretary of Transportation	• Manages the project application process • Includes Office of Intermodal Planning (OIPI), Department of Rail and Public Transportation (DRPT), and Virginia Department of Transportation (VDOT) • OIPI screens and reviews projects against HB2 screening criteria to determine eligibility to compete in evaluation process • VDOT and DRPT determine ratings for each project • The Secretary of Transportation's Office provides the final evaluation to CTB and to the public
Technical Evaluation Team	• Responsible for conducting measure calculations and creating the qualitative rating assessments for each factor for each submitted project • Comprised of technical staff from DRPT and VDOT that have experience with subject matter and analytical tools • Evaluate project preparation • Calculate scores for submitted projects according to methodologies documented in the Implementation Guide • Allows second team to evaluate to ensure consistency
External Peer Review	• Comprised of representative from Virginia Association of Counties, Virginia Municipal League, FHWA, and other groups • Review projects, evaluations, and scores to ensure consistency

[24] HB2 Implementation Policy Guide. August 1, 2015. http://www.virginiahb2.org/documents/hb2policyguide_8-1-2015.pdf
[25] HB2 Implementation Policy Guide. August 1, 2015. http://www.virginiahb2.org/documents/hb2policyguide_8-1-2015.pdf

STEP 4.2.1	Identify and assign internal roles and responsibilities

Massachusetts Department of Transportation

Section 11 of Chapter 46 of the Acts of 2013 established a Project Selection and Advisory Council (the Council) charged with developing uniform project selection criteria.[26] The Council is comprised of representatives from key external stakeholders such as MPOs, RTAs, municipalities, advocacy organizations, and others. The mission of the Council states:

> With due consideration of the requirements of fiscal constraint, federal funding restrictions, regional priorities, geographic equity, environmental justice and state of good repair, and in a manner that balances the need for responsive and transparent adaptability to unanticipated changes in funding, project readiness or in the event of an emergency or public safety need, the Project Selection Advisory Council, as established by the Massachusetts Legislature in Section 11 of Chapter 46 of the Acts of 2013, seeks to review existing statewide project evaluation criteria and prioritization processes for Massachusetts' multi-modal transportation system. The PSA Council will recommend changes for a more uniform, transparent and data-driven prioritization process that reflects MassDOT's mission to provide our nation's safest and most reliable transportation system to strengthen our economy and quality of life across the Commonwealth.

Over an 18-month period, the Council met regularly and consulted with the public and legislature. On July 1, 2015, "Recommendations for MassDOT Project Selection Criteria" was delivered, focusing primarily on modernization and capacity projects. The project selection criteria defined in this effort is illustrated below.

[26] Massachusetts Department of Transportation. (2015). Recommendations for MassDOT Project Selection Criteria. Boston, MA. https://www.massdot.state.ma.us/Portals/0/docs/PSAC/Report_Recom.pdf

STEP 4.2.1	Identify and assign internal roles and responsibilities

Figure 4-9: MassDOT Project Selection Criteria

Source: Recommendations for MassDOT Project Selection Criteria[27]

Maryland Transit Administration

The Maryland Transit Administration (MTA) is one of the modal administrations within the Maryland Department of Transportation and has developed an in-house Excel-based spreadsheet tool to prioritize projects across performance areas. The Programming Office within MTA requests project submissions from across the agency, and then distributes the list of projects to seven Deputy Chiefs, along with senior staff representing operations, engineering, administrative support, planning, and safety. Each Deputy Chief initially ranks each project on a one to three scale based on the perspective of their performance area and then the group meets to discuss variations in the assessments. Once scoring is complete, projects are entered into the decision matrix tool and results are provided to agency leadership to assist in making funding decisions.

Linkages to Other TPM Components	Component A: Organization and Culture	(See TPM Framework)

STEP 4.2.2	Clarify purpose of cross performance area prioritization

Description

Agencies take different approaches to cross performance area programming based on particular circumstances. In some agencies with more developed project selection and funding allocation, methodologies for specific performance areas may decide that such projects will not be subject to cross-area prioritization because the process is data driven and is producing

[27] Massachusetts Department of Transportation. (2015). Recommendations for MassDOT Project Selection Criteria. Boston, MA. https://www.massdot.state.ma.us/Portals/0/docs/PSAC/Report_Recom.pdf

STEP 4.2.2	Clarify purpose of cross performance area prioritization

	good results. However, if an agency finds that it is not achieving desired results under its current regimen, this should be reconsidered. Other agencies may want to include all projects regardless of how data-driven later programming is.
	
	Whichever approach is chosen, it must be clearly documented which project types will and will not be evaluated using this process. The purpose of the prioritization should be stated and clearly communicated to all involved, including any agencies that will submit a project for funding.
	
	In addition, the agency should clearly document why this new approach is necessary, for example:
	• Virginia Department of Transportation:
	  ○ Increase transparency and accountability for project selection and to make the process objective
	  ○ Improve stability in the Six-Year Improvement Program
	• MassDOT:
	  ○ Invest in transportation needs to build public confidence
	  ○ Maximize return on investment in terms of traditional economic ROI but also in terms of quality of life and sustainability
	  ○ Address significant backlog
	  ○ Deal with acute funding constraints
	• NCDOT:
	  ○ Increase transparency of process
	  ○ Remove politics from transportation decision-making (strong public desire)
	• Maryland Transit Administration:
	  ○ Provide a common set of performance-based criteria to asses a range of assets (e.g., vehicles, infrastructure, stations, maintenance facilities)
	  ○ Reflect political and legal mandates while also highlighting MTA's strategic direction (e.g., exceptional customer service)
	• Delaware Valley Regional Planning Commission
	  ○ Apply universal criteria that can evaluate a variety of modes (roadway, transit, bike, pedestrian and freight) to provide the means to effectively balance programming of the region's needs and resources.
	
	Once the universe of eligible projects has been determined and the purpose of the cross-area prioritization has been determined, the agency must determine how projects will be evaluated. Project selection criteria based on particular measures will help an agency achieve an objective, data-driven process. Using existing data will be most expedient, but additional measures can be added or substituted in future iterations of project scoring. Refer to Implementation Step 4.1.2, "Develop project selection criteria," for further information.

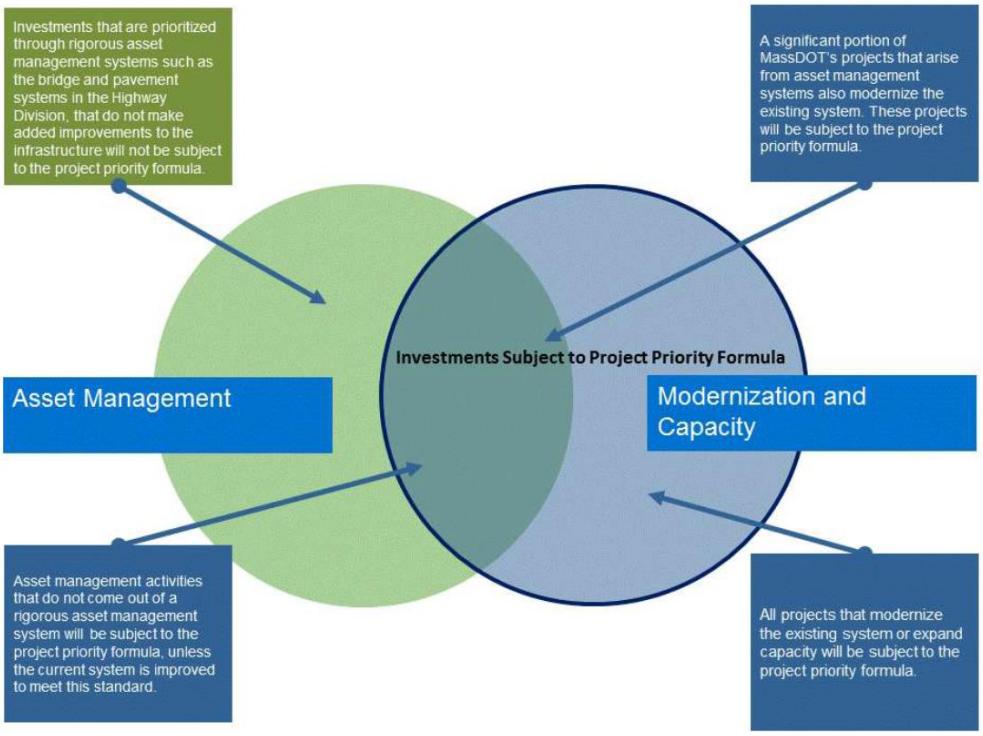
Examples	The **Massachusetts Department of Transportation** developed a project prioritization framework for cross-asset allocation. The group in charge of developing this policy debated at length over what project types would be subject to prioritization, determining that two project categories (Modernization and Capacity) would be included. Asset management and basic state of good repair projects would not be included if they underwent rigorous prioritization within the asset silo. Asset management projects not subject to this sort of review would be

STEP 4.2.2	Clarify purpose of cross performance area prioritization

included in the new prioritization process. The graphic below demonstrates this point. Blue boxes show projects to be included in the prioritization process and explain the rationale behind this decision.

Figure 4-10: MassDOT Prioritization Process

Source: Recommendations for MassDOT Project Selection Criteria[28]



MassDOT chose to exclude basic asset management projects from project prioritization because many of these projects have straightforward scopes and predictable impacts on performance, making comparison to other projects less useful. However, the agency does acknowledge that there is a need to prioritize these projects in some way because funding consistently falls short of need. To this end, the agency decided that mature asset management systems would continue to be used as-is to prioritize projects (green box). Those projects that go beyond asset management to modernize or add capacity are subject to prioritization through this new system (blue boxes on right).[29]

Linkages to Other TPM Components	Component B: External Collaboration and Coordination (See TPM Framework) Component 05: Monitoring and Adjustment Component 06: Reporting and Communication

[28] Massachusetts Department of Transportation. (2015). Recommendations for MassDOT Project Selection Criteria. https://www.massdot.state.ma.us/Portals/0/docs/PSAC/Report_Recom.pdf

[29] Massachusetts Department of Transportation. (2015). Recommendations for MassDOT Project Selection Criteria. https://www.massdot.state.ma.us/Portals/0/docs/PSAC/Report_Recom.pdf

STEP 4.2.3	Develop a methodology that reflects agency priorities and external stakeholder interests
Description	Cross performance area prioritization methodology must reflect both agency priorities and external stakeholder desires. The agency has already spelled out its priorities by establishing goals in the Strategic Direction (Component 01). Now the agency goes a step further by prioritizing these goals; while all goals are important to an agency, success of cross performance area prioritization hinges on a clear understanding of which performance areas are most important and should receive adequate funding to enable desired performance levels. By favoring particular goal areas, others will be subject to reduced or at least stable funding which may impact performance outcomes. A tradeoff analysis is critical to understanding what these impacts are likely to look like so that staff can make an informed decision about funding levels based on results achieved. Input from external stakeholders is important to ensure that goal areas prioritized internally by agency staff match as much as possible to areas where partner agencies and the public desire improved performance. An agency should seek to gather input on goal area prioritization as well as on evaluation of specific projects as projects are scored based on selection criteria. Once a prioritized list of projects is determined, a tradeoff analysis within budget constraints is a critical part of understanding performance impacts based on varying funding levels across performance areas. Another important consideration is funding program rules, which may restrict what an agency can spend where. This will limit cross-performance area prioritization to some degree unless funding restrictions are adjusted. "This is not a mechanical process – scores influence decisions but do not dictate them. If the project has a high score, an agency is not forced to fund it. However, if a project has a low score and an agency wants to fund it, than the sponsor needs to come up with a solid justification." - Ron Achelpohl, Mid-America Regional Council
Examples	**North Carolina Department of Transportation** The Strategic Transportation Investments Law passed in 2013[30] establishes the Strategic Mobility Formula, which creates a data-driven scoring method for allocating resources. The formula takes into account local input from MPOs, RPOs, and Divisions to evaluate projects after all have been given quantitative scores based on established measures related to crashes, pavement condition, travel time savings, and others. Two of three project categories (Division Needs and Regional Impact) are scored with local input according to the formula: **Total = Quantitative Data + Local Input**

[30] NCGS § 136-189. http://www.ncleg.net/Sessions/2013/Bills/House/PDF/H817v10.pdf

STEP 4.2.3	Develop a methodology that reflects agency priorities and external stakeholder interests

The third project category (Statewide Mobility) is based entirely on data. Each organization receives an equal number of points to distribute among the total projects under evaluation and can choose two methods:[31]

Table 4-6: Two Methods for Project Evaluation

Source: Adapted from NCDOT Strategic Planning Office Presentation[32]

Method	Top 25	Control Total
Description	#1 = 100 #2 = 96 #3 = 92 … #25 = 4	Can rank projects as desired Maximum 100 points per project Minimum 4 points per project

By ranking the organization's top 25 desired projects, the final list can be easily communicated to the public and other stakeholders less familiar with the project; the Control Total alternative provides an opportunity for more fine-tuning. Both methods use the same number of total points. MPO/RPO evaluation is based on the particular organization's methodology to rank and prioritize projects internally and Divisions use knowledge of the area to assist in their ranking.

The **Virginia Department of Transportation** prioritized agency goals differently for different parts of the state by creating Area Typologies. The table demonstrates how goal priorities vary by Typology. The map of typologies, available at http://www.virginiahb2.org/about/, shows what Typology applies to particular locations. This approach allows the state to focus on the most important needs in particular areas, ensuring that the most appropriate projects are selected to impact the most pressing issues of those areas.[33]

VDOT also created a separate category called High Priority Projects, which includes projects that address designated Corridors of Statewide Significance or Regional Networks. These are the most important projects in the state according to agency priorities.

Table 4-7: VDOT Area Typologies

Source: Adapted from About HB2[34]

Factor	Congestion Mitigation	Economic Development	Accessibility	Safety	Environmental Quality
Category A	45%	5%	15%	5%	10%
Category B	15%	20%	25%	20%	10%
Category C	15%	25%	25%	25%	10%
Category D	10%	35%	15%	30%	10%

[31] NCDOT Strategic Planning Office Presentation. http://www.ncdot.gov/download/performance/prioritization2jan2012.pdf
[32] NCDOT Strategic Planning Office Presentation. http://www.ncdot.gov/download/performance/prioritization2jan2012.pdf
[33] About HB2. June 9, 2016. http://www.virginiahb2.org/about/
[34] About HB2. June 9, 2016. http://www.virginiahb2.org/about/

STEP 4.2.3	Develop a methodology that reflects agency priorities and external stakeholder interests

The **Delaware Valley Regional Planning Commission** developed nine universal criteria to evaluate projects to be added to the Transportation Improvement Program (TIP). The criteria were defined through a collaborative process with Pennsylvania and New Jersey members of a working subcommittee of the DVRPC Regional Technical Committee (RTC) and included staff from the State DOTs, transit agencies and bicycle and pedestrian representatives. The selected criteria were designed to align directly with the multimodal goals of the *Connections 2040 Plan*, the region's long-range plan, and reflect the increasingly multimodal nature of the TIP.

The following characteristics were used to define the benefit criteria:

- Align with the Long-Range Plan and other regional objectives;
- Be relevant to different types of TIP projects;
- Indicate differences between projects;
- Avoid measuring the same goal(s) multiple times;
- Cover the entire nine-county region;
- Be more quantitative than qualitative;
- Use readily available data with a strong likelihood of continued availability; and
- Be simple and understandable

The resulting eight criteria were used to evaluate all TIP projects regardless of mode. This enabled DVRPC to uniformly communicate the benefits of the projects contained in the TIP. What was customized for the different modes was the specific measure used for each criterion. For example, below are the transit, roadway and bridge measures used for the "Facility/Asset Condition" criterion:[35]

Figure 4-11: DVRPC Facility and Asset Criteria

Source: FY 2015 Transportation Improvement Program, Appendix D[36]

Facility / Asset Use	Daily VMT	Roadway Management System (RMS),	1 point if the average AADT of all road segments multiplied by the total length of the segments within the project limits is more than 500,000; else total daily VMT divided by 500,000. For computation of VMT, projects that only involve bridges or intersections assume that each of these facilities is 1 mile in length. In this case the value will be the average AADT multiplied by the number of bridges or intersections. Projects where bridge or intersection improvements are a part of a larger scope will rely on the limits of the larger project.
	Daily Trucks	Roadway Management System (RMS),	1 point if the average road segment has more than 7,500 trucks or truck equivalents per day; else trucks or truck equivalents per day divided by 7,500.
	Daily Transit Riders	Transit Agencies,	1 point if the number of daily transit riders affected is 50,000 or above; else daily affected ridership divided by 50,000.

After defining the "benefit criteria," the submitting agency evaluated each project submitted to the TIP. It should be noted that the eight benefits criteria were not used to identify projects to exclude from the TIP. Instead, the criteria created a common language for each submitting agency to describe the benefits of their set of TIP projects. The criteria development process and resulting criteria were documented in the FY 2015 TIP, but the score and ranking of the TIP projects were not publically released.

DVRPC uses the benefit criteria to communicate why these projects were necessary for the region to attain its multimodal goals.

[35] Delaware Valley Regional Planning Commission. *FY 2015 Transportation Improvement Program, Appendix D*. http://www.dvrpc.org/TIP/pafinal/2015/DVRPC-TIP-Project-Benefit-Criteria-2015.pdf

[36] Delaware Valley Regional Planning Commission. *FY 2015 Transportation Improvement Program, Appendix D*. http://www.dvrpc.org/TIP/pafinal/2015/DVRPC-TIP-Project-Benefit-Criteria-2015.pdf

STEP 4.2.3	Develop a methodology that reflects agency priorities and external stakeholder interests
Linkages to Other TPM Components	Component B: External Collaboration and Coordination Component C: Data Management Component D: Data Usability and Analysis (See TPM Framework)

STEP 4.2.4	Document the process
Description	Documentation is a critical part of every process in this guidebook, and this remains true for cross-performance area programming. Because this process is heavily dependent on data, scoring, measures, and various priorities, it is extremely important to document. In addition, many agencies choose to implement this process as part of an effort to increase transparency related to project funding and budget allocation; without proper documentation, the process will still seem like a black box. **In addition to documenting how the process was established and conducted, the agency must document:** • Project selection criteria and how they were determined • Formulas for project evaluation and justification behind the approach • Why certain goal areas were prioritized • Impacts on performance from tradeoff analyses • What alternatives were not chosen and why • Roles and responsibilities • Project eligibility • Project submission process • Timeline for submission, evaluation, and publication of final results • Input received from external stakeholders • Risk factors that may impact program delivery and effectiveness • Output targets that can be used to track anticipated effects of projects
Examples	The **North Carolina DOT** publicly documents scores given to each project evaluated through the cross-area performance prioritization process. The image below is a very small portion of the file posted online at: https://connect.ncdot.gov/projects/planning/STIData/Forms/AllItems.aspx. The Excel files are available for download and include project information, cost, and evaluative scores by partner agencies as well as the quantitative scores given by NCDOT. Making this wealth of information available goes a long way toward increasing transparency of the programming process.

STEP 4.2.4	Document the process

Figure 4-12: NCDOT Prioritization Scoring

Source: Planning – STI Data[37]

Statewide Mobility Quantitative Score (Out of 100)	Regional Impact Quantitative Score (Out of 70)	Division Needs Quantitative Score (Out of 50)
N/A	N/A	11.20
N/A	9.76	7.33
43.56	30.20	20.84
N/A	10.38	7.32
N/A	23.06	16.68

The **Virginia DOT** clearly documents cross-performance area programming. The table below lists some of the measures that are used to evaluate projects, organized by goal area. It also indicates how each measure contributes to the overall performance area score. This information is available on a publicly accessible website for ease of use and understanding: http://www.virginiahb2.org/about.

Table 4-8: VDOT Documentation

Source: Adapted from About HB2[38]

Performance Area	Measure	Contribution
Safety	Number of fatal and injury crashes	50%
Safety	Rate of fatal and injury crashes	50%
Congestion Mitigation	Person throughput	50%
Congestion Mitigation	Person hours of delay	50%
Accessibility	Access to jobs	60%
Accessibility	Access to jobs for disadvantaged persons	20%
Accessibility	Access to multimodal choices	20%
Environmental Quality	Air quality and environmental effect	50%
Environmental Quality	Impact to natural and cultural resources	50%

Linkages to Other TPM Components

Component A: Organization and Culture (See TPM Framework)

Component 05: Monitoring and Adjustment

Component 06: Reporting and Communication

[37] Planning – STI Data. June 9, 2016. https://connect.ncdot.gov/projects/planning/STIData/Forms/AllItems.aspx
[38] About HB2. June 9, 2016. http://www.virginiahb2.org/about/

RESOURCES

Resource	Year	Link
TPM Toolbox	2016	www.tpmtools.org
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf
Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities	2012	http://www.fhwa.dot.gov/asset/pubs/hif12035.pdf
FHWA Scenario Planning Guidebook	2011	http://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook/
Defining Cross-Asset Decision Making: A Discussion Paper	2015	http://www.tam-portal.com/wp-content/uploads/2016/01/Cross-Asset-Allocation.pdf
Flexible Funding for Highway and Transit	Ongoing	http://www.fta.dot.gov/grants/12867.html

ACTION PLAN

1. Of the TPM subcomponents discusses in this chapter, which one would you like to work on?

❑ 4.1 Programming Within Performance Areas ❑ 4.2 Programming Across Performance Areas

2. What aspect of the TPM process listed above do you want to change?

3. What "steps" discussed in this chapter do you think could help you address the challenge noted above?

Programming Within Performance Areas

- ❑ Clarify roles of internal staff and external stakeholders
- ❑ Develop project selection criteria
- ❑ Establish a formal input process to gather performance-based project information
- ❑ Document the process

Programming Across Performance Areas

- ❑ Identify and assign internal roles and responsibilities
- ❑ Clarify purpose of cross performance area prioritization
- ❑ Develop a methodology that reflects agency priorities and external stakeholder interests
- ❑ Document the process

4. To implement the "step" identified above, what actions are necessary, who will lead the effort and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success?

6. Who is someone (internal and/or external) I will collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

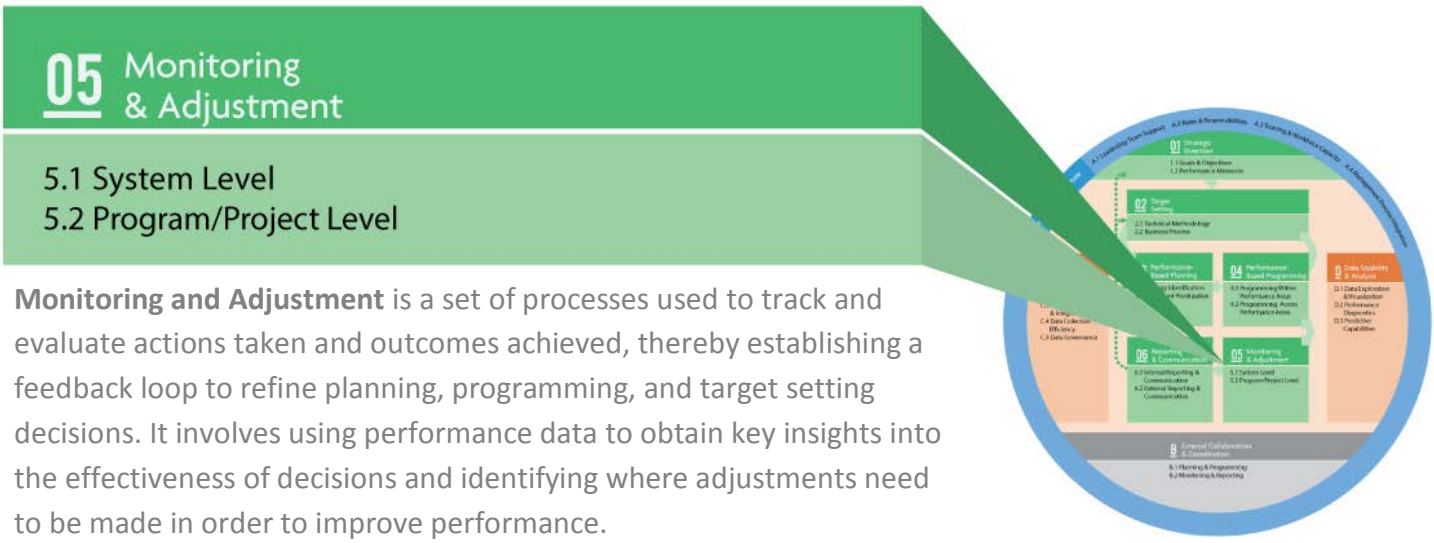
TABLE INDEX

U.S. Department of Transportation
Federal Highway Administration

COMPONENT 5

MONITORING & ADJUSTMENT

This chapter provides assistance to transportation agencies with the "Monitoring and Adjustment" component of Transportation Performance Management (TPM). It discusses where monitoring and adjustment occurs within the TPM Framework, describes how it interrelates with the other nine components, presents definitions for associated terminology, provides links to regulatory resources, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for monitoring and adjustment may differ from what is included in this chapter.



Monitoring and Adjustment is a set of processes used to track and evaluate actions taken and outcomes achieved, thereby establishing a feedback loop to refine planning, programming, and target setting decisions. It involves using performance data to obtain key insights into the effectiveness of decisions and identifying where adjustments need to be made in order to improve performance.

INTRODUCTION

Transportation agencies have been monitoring performance results for some time. However, it is what agencies do with the monitoring information that ends up distinguishing transportation performance management from performance measurement. Under a simple performance measurement framework, an agency sets a strategic direction, defines measures and tracks results. There are many benefits associated with these three elements including the establishment of the agency's purpose, improved communication of performance trends, and enhanced accountability. To move into the realm of transportation performance management, agencies must actively use information gained from monitoring performance data to obtain key insights into the effectiveness of decisions and identifying where adjustments need to be made. The combination of monitoring and adjustment processes is the "bread and butter" of TPM, establishing a critical feedback loop between performance results and future planning, programming and target setting decisions.

Establishment of robust monitoring and adjustment practices benefits an agency by:

- Providing early warning of emerging project delivery and system performance issues;
- Discovering new insights into causal factors contributing to performance outcomes;
- Highlighting needed adjustments to project and programs based on actual results;
- Identifying data gaps that need to be closed;
- Providing a reality check on performance targets; and
- Enhancing the understanding of which strategies are effective and why.

> "Embrace the power of "why"—Focusing on the why clearly communicates that performance management intends to understand the results and identify improvements, not to punish."
>
> Source: "Moving from Reactive to Strategic Decisions Making." TR News 293 July-August 2014

Through monitoring and adjustment practices, an agency can answer, "Are we getting the results we anticipated"? as well as "If not, why not"? The ongoing review of observed results helps agencies identify, diagnose, and act upon program delivery issues. This process also identifies where data gaps exist and highlights where additional information would be beneficial. As an agency's understanding of the relationship between actions taken and performance results improves, so will an agency's ability to make necessary mid-stream adjustments, select future projects and programs to achieve desired outcomes, and explain performance results to stakeholders. Given that TPM practices evolve over time, monitoring and adjustment processes provide valuable material upon which future iterations can build.

The processes implemented under the monitoring and adjustment component focus on the outputs and outcomes of specific transportation projects and programs as well as the performance of the overall transportation system. Outputs refer to the quantity of activity delivered through a project or program: the miles of pavement repaved, the number of bridges rehabilitated, the number of new buses purchased, etc. Outputs are important to track in order to evaluate whether the project or program is on scope, on time and on budget. Did the agency deliver the level of activity that was promised? Outcomes refer to the results of interest to users of the transportation system: travel time reliability, fatality rates, etc. An effective monitoring and adjustment process must look at both output and outcomes to create a strong connection between investment decisions and results.

Through this TPM component, an agency examines what actions are accomplishing the desired impact(s) on performance results (Figure 5-1) and considers why they have been effective or not. Progress toward targets is gauged as well as whether those targets are reasonable. Linking decisions to results reveals potential adjustments needed to deliver the projects, as well as further refinement of the selection of strategies. As a result, the Monitoring and Adjustment component has a clear, direct linkage to Target Setting (Component 02), Performance-Based Planning (Component 03) and Performance-Based Programming (Component 04). By closely analyzing the relationship between actions and results, this component strengthens the connection between what agency staff does on a daily basis and the ultimate strategic goals an agency is trying to achieve (Strategic Direction, Component 01). The information gathered through monitoring and adjustment processes creates a foundation for the external and internal products developed under Reporting and Communication (Component 06), agency management functions (Organization and Culture, Component A), and may assist in the fulfillment of local, state, and Federal regulatory requirements.

Activity refers to an action taken to implement a strategy (e.g., purchase additional maintenance vehicles).

Output refers to "level of activity" (e.g., number of miles repaved).

Outcomes demonstrate the "effectiveness" of a particular activity (e.g., travel time reliability).

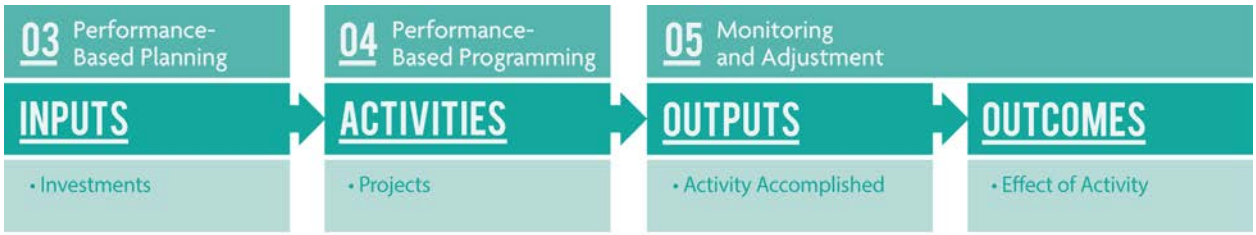
Sources: NCHRP Report 446, Guidebook for Performance-Based Planning; FHWA, Performance Based Planning and Programming Guidebook

Since the monitoring and adjustment component helps agencies understand and react to the pursuit of established targets and strategic goals, the more established an agency's strategic direction and target processes are, the easier it will be to implement monitoring and adjustment processes. In some agencies, monitoring and adjustment may take place naturally, as part of an established transportation performance management process, whereas in others, the steps must be put in place purposefully, in order to emphasize the importance of the relationship between decisions and results. This relationship is cemented through well-defined monitoring and adjustment processes.

A well-crafted monitoring framework allows an agency to determine whether progress is taking place in advance of deadlines for required reporting and, if necessary, enable adjustments to programming so that significant progress is more likely to be attained. An agency may also need to use monitoring information to justify the setting of a new target. Ongoing monitoring and adjustment enables an agency to track the activities it is undertaking and the outputs produced (direct results of an activity, such as miles of pavement resurfaced), and the impact on outcomes (broader effects such as improved mobility or access to activity centers). Reporting and Communication (Component 06) describes steps an agency can take to effectively communicate this documentation to internal and external audiences.

Figure 5-1: Relationship Between Inputs and Outcomes

Source: Federal Highway Administration

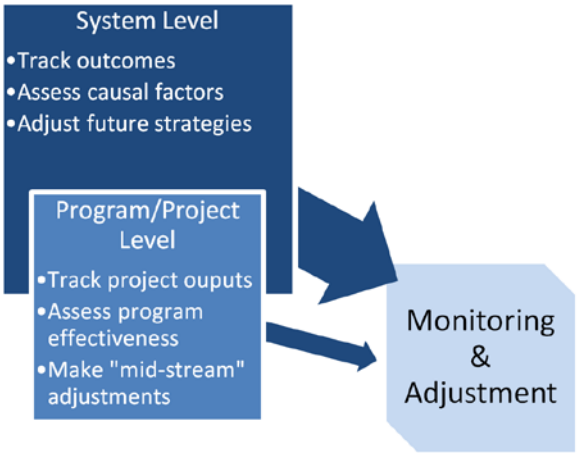


SUBCOMPONENTS AND IMPLEMENTATION STEPS

The definition for Monitoring and Adjustment is: a set of processes used to track and evaluate actions taken and outcomes achieved, thereby establishing a feedback loop to refine planning, programming, and target setting decisions. It involves using performance data to obtain key insights into the effectiveness of decisions and identifying where adjustments need to be made in order to improve performance. The component is comprised of two subcomponents, with the Program/Project Level Monitoring and Adjustment subcomponent nested within the System Level Monitoring and Adjustment subcomponent:

Figure 5-2: Subcomponents for Monitoring and Adjustment

Source: Federal Highway Administration



- **System Level Monitoring and Adjustment:** Establishment of a well-defined performance-monitoring process to understand past and current performance. The analysis of performance results leads to an improved understanding of causal factors and increases an agency's ability to act on new insights. This enhanced understanding of why performance results occurred feeds future planning and programming decisions. Within this system outcome viewpoint, Program/Project Level Monitoring and Adjustment clarifies the contribution of specific programs and projects on achieving goals, objectives and targets.
- **Program/Project Level Monitoring and Adjustment:** Establishment of a process for tracking program and project outputs, and their effects on performance outcomes. This process provides early warning of potential inability to achieve performance targets. Insights are used to make project or program "mid-stream" adjustments and guide future programming decisions. This subcomponent provides a before/after project-level view and is nested within the System Level Monitoring and Adjustment subcomponent.

System Level Monitoring and Adjustment

System level monitoring and adjustment focuses on the linkage between resource allocation decisions and the achievement of strategic goals and objectives. A well-defined monitoring process helps agencies diagnose information on factors that affect outcomes such as available funding and external economic, environmental and social trends. Refining agency monitoring processes, the collection of additional data, and improved analysis capabilities provides new insights into causal factors contributing to performance. A key characteristic of this subcomponent is the application of performance monitoring information to identify where adjustments need to be made. These insights in turn can be used in future planning and programming decisions. System level monitoring typically has a wider scope and a long-range time horizon. An understanding of the relationship between actions and results can take years to assess—as is the case within the safety performance area.

> "The purpose of PBPP is to ensure that results of previous investments and policies inform future decision-making so that transportation agencies can better understand approaches that work best given constraints and conditions."
>
> Source: FHWA, Performance Based Planning and Programming Guidebook

Program/Project Level Monitoring and Adjustment

The program/project level monitoring and adjustment subcomponent assesses specific programs and projects. This includes summary statistics such as dollars expended or outputs delivered. In addition, analyses are conducted to

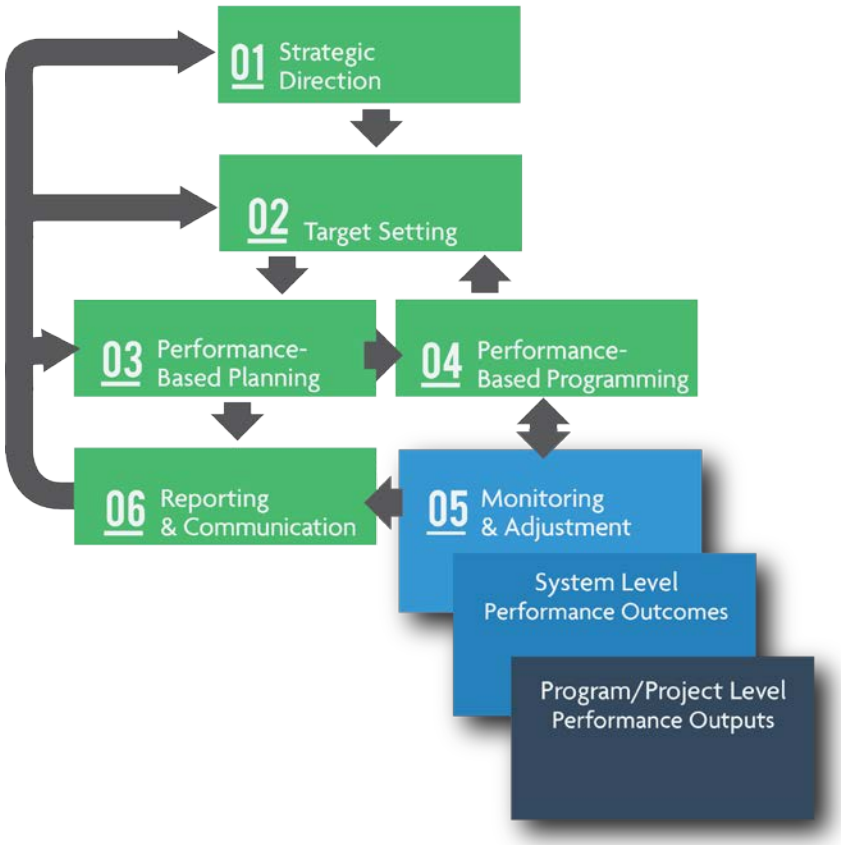
gain a better understanding of the effectiveness of a project or program on desired performance targets. The program/project level monitoring process typically has a narrow focus (e.g., speed improvements resulting from a traffic flow improvement project) and has a shorter timeframe than system monitoring and adjustment efforts. A well-defined program monitoring process gives an agency a better understanding of risk factors that could impact its ability to deliver the program and improves early warning of emerging issues. In addition, before/after studies give agencies new insights into causal factors that may be strong drivers of performance outcomes. With this additional diagnostic information, agencies are able to make project or program adjustments "mid-stream" to address delivery issues, improve the effectiveness of projects and better guide future decisions. In short, program/project level monitoring gives agencies the information necessary to understand, diagnose and act upon delivery issues. Over time, the regular process of monitoring the effect of implemented programs and projects will guide future planning, programming, and target setting decisions.

Outline of Implementation Steps

The importance of linking actions and results is the reason that monitoring and adjustment takes the form of a distinct component within the TPM framework. Although the "monitoring" lens through which the programs and project or system performance varies by scope and time horizon, these processes help agencies understand what progress is being made toward established targets and strategic goals. Together, program/project level and system level monitoring and adjustments establish a critical feedback loop between performance results and future planning, programming, and target setting decisions (see Figure 5-3). However, it is the active use of monitoring information to identify and implement adjustments that makes this component the cornerstone of TPM.

Figure 5-3: TPM Components Flowchart

Source: Federal Highway Administration



Both Monitoring and Adjustment subcomponents are intended to provide actionable information to an agency, with one nested within, and informing, the other. The steps necessary to implement program/project level and system level monitoring and adjustment processes are in Table 5-1. How these steps are applied within the two subcomponents is further explored in this chapter.

Table 5-1: Monitoring and Adjustment Implementation Steps

Source: Federal Highway Administration

System Level and Program/Project Level
1. Determine monitoring framework
2. Regularly assess monitoring results
3. Use monitoring information to make adjustments
4. Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions
5. Document the process

CLARIFYING TERMINOLOGY

Table 5-2 provides definitions for the target setting terms used in this Guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table 5-2: Monitoring and Adjustments: Defining Common TPM Terminology

Source: Federal Highway Administration

Common Terms	Definition	Example
Activity	Refers to actions taken by transportation agencies, such as projects, related to strategy implementation.	Paving key locations, adding new guardrail, rehabilitating a bridge, purchasing new buses.
Adjustment	The alteration of programming, planning, targets, measures, and goals resulting from analysis of information collected.	The restriping of a construction project to address an observed increase in traffic incidents.
Goal	A broad statement of a desired end condition or outcome; a unique piece of the agency's vision.	A safe transportation system.
Monitoring	The identification and diagnosis of performance systems and programs.	Freeway and Arterial System of Transportation (FAST), a real-time traffic condition dashboard that enables detailed analysis on request.
Objective	A specific, measurable statement that supports achievement of a goal.	Reduce the number of motor vehicle fatalities.
Outcome	Results or impacts of a particular activity that are of most interest to system users. Focus of subcomponent 5.1 System Level Monitoring and Adjustment.	Transit travel time reliability, fatality rate, percent of assets within useful life.

Common Terms	Definition	Example
Output	Quantity of activity delivered through a project or program. Focus of subcomponent 5.2 Program/Project Level Monitoring and Adjustment.	Miles of pavement repaved, miles of new guardrail put into place, the number of bridges rehabilitated, the number of new buses purchased.
Performance Measure	Performances measures are based on a metric that is used to track progress toward goals, objectives, and achievement of established targets. They should be manageable, sustainable, and based on collaboration with partners. Measures provide an effective basis for evaluating strategies for performance improvement.	Transit passenger trips per revenue hour.
Performance Period	An established timeframe for monitoring results and collecting data and information for performance reporting.	A calendar year.
Reporting	Summary documentation of performance trends for either internal or external audiences.	WSDOT Gray Notebook.
Sub-Measure	A detailed quantifiable indicator uncovered during monitoring that provides additional insights into internal and external processes.	Preventive maintenance compliance—a driver of overall asset performance.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.

RELATIONSHIP TO TPM COMPONENTS

The ten TPM components are interconnected and often interdependent. However, the monitoring and adjustment component is particularly notable given that it serves as the critical feedback loop within the TPM Framework. As the means to answering the questions, "Are we getting the results we anticipated"? as well as "If not, why not"? this component helps agencies determine progress toward performance targets (Component 02) and in turn, strategic goals (Component 01). Through an increased understanding of the effect of specific projects and programs on outcomes, the monitoring and adjustment component uncovers information to be used in future planning (Component 03) and programming (Component 04) decisions. This monitoring and adjustment component helps agency staff link their day-to-day activities to results and ultimately agency goals (Organization and Culture, Component A). The external and internal reporting and communication products (Component 06) are based on the information gathered during monitoring and adjustment. Finally, the cornerstone of all TPM components is quality data. By establishing well-defined monitoring and adjustment processes, the quality of the data agencies use will naturally improve and enable identification of data gaps that need to be addressed.

Linkages between monitoring and adjustment and the other nine TPM components are depicted in Table 5-3.

Table 5-3: Monitoring and Adjustment Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to Monitoring and Adjustment
01. Strategic Direction	The establishment of an agency's focus through well-defined goals/objectives and a set of aligned performance measures.	The information uncovered during the monitoring and adjustment phase helps agencies assess progress toward the goals and objectives defined under the strategic direction.
02. Target Setting	The use of baseline data, information on possible strategies, resource constraints, and forecasting tools to collaboratively establish targets.	As agencies better understand the effectiveness of projects and programs through monitoring and adjustment, the feasibility of attaining targets will be clearer, resulting in potential target adjustments.
03. Performance-Based Planning	Use of a strategic direction to drive development and documentation of agency strategies and priorities in the long-range transportation plan and other plans.	Reviewing performance trends through monitoring and adjustment provides key insights into the actual versus predicted effectiveness of alternative strategies (before/after analysis) with respect to agency goals. Monitoring establishes a key feedback loop to future planning decisions, including necessary strategy adjustments and the identification of new strategies.
04. Performance-Based Programming	Allocation of resources to projects to achieve strategic goals, objectives and performance targets. Clear linkages established between investments made and their expected performance outputs and outcomes.	Improved knowledge about influencing factors and the relationship between investments and performance results explored through monitoring processes will improve the assumptions used for future programming decisions.
06. Reporting and Communication	Products, techniques, and processes to communicate performance information to different audiences for maximum impact.	The monitoring and adjustment process provides a foundation for external and internal reporting and communication products regarding performance. This component also provides the explanation for why target and program adjustments are necessary.
A. TPM Organization and Culture	Institutionalization of a TPM culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support TPM.	Monitoring and adjustment strengthens the connection between what agency staff do on a daily basis and the ultimate strategic goals and agency is trying to achieve. This component provides a forum for leadership to better understand performance results, provide support, and assign roles and responsibilities as needed.
B. External Collaboration and Coordination	Established processes to collaborate and coordinate with agency partners and stakeholders on planning/ visioning, target setting, programming, data sharing, and reporting.	Examining the relationship between programs and performance results will create a pool of data and analysis that can be shared with external partners to clarify and explain adjustments made.

Component	Summary Definition	Relationship to Monitoring and Adjustment
C. Data Management	Established processes to ensure data quality and accessibility, and to maximize efficiency of data acquisition and integration for TPM.	Monitoring and adjustment processes are dependent on the availability of timely, accurate and authoritative data.
D. Data Usability and Analysis	Existence of useful and valuable data sets and analysis capabilities, provided in usable, convenient forms to support TPM.	Through regular performance monitoring, the quality of the data agencies use will improve, and data gaps that need to be closed will be identified (e.g., "sub-measures" that provide new insights into factors influencing performance results).

REGULATORY RESOURCES

This Guidebook is intended to assist agencies with implementing transportation performance management in a general sense and not to provide guidance on compliance and fulfillment of Federal regulations. However, it is important to consider legislative requirements and regulations when using the Guidebook. In many cases, use of this Guidebook will bring an agency in alignment with Federal requirements; however, the following sources should be considered the authority on such requirements:

Federal Highway Administration

- Transportation Performance Management: http://www.fhwa.dot.gov/tpm/links_fhwa.cfm
- Fact Sheets on Fixing America's Surface Transportation (FAST) Act: https://www.fhwa.dot.gov/fastact/factsheets/
- Fact Sheets on Moving Ahead for Progress in the 21st Century (MAP-21): https://www.fhwa.dot.gov/map21/factsheets/
- Resources on MAP-21 Rulemaking: https://www.fhwa.dot.gov/tpm/rule.cfm

Federal Transit Administration

- Fact Sheets on FAST Act: https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-fast-act
- Resources on MAP-21: https://www.transit.dot.gov/regulations-and-guidance/legislation/map-21/map-21-program-fact-sheets

IMPLEMENTATION STEPS

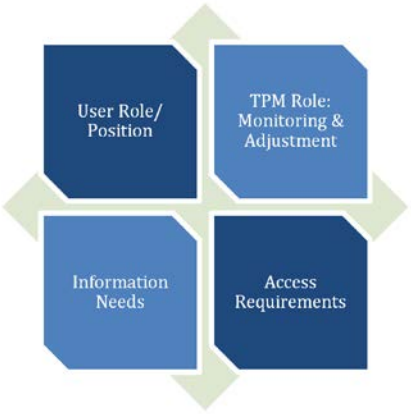
5.1 SYSTEM LEVEL

The system level monitoring and adjustment subcomponent focuses on the linkage between resource allocation decisions and the achievement of strategic goals and objectives. A well-defined monitoring process helps agencies diagnose information on factors that affect outcomes such as available funding and external economic, environmental and social trends. Refining agency monitoring processes, collecting additional data, and improved analysis capabilities provides new insights into causal factors contributing to performance. A key characteristic of this subcomponent is the application of performance monitoring information to identify where adjustments need to be made. These insights can be used in future planning and programming decisions. System level monitoring typically has a wider scope and a long-range time horizon. Understanding the relationship between actions and results can, in some instances, take years to assess. The following section outlines steps agencies can follow to establish system level monitoring and adjustment processes.

1. Determine monitoring framework
2. Regularly assess monitoring results
3. Use monitoring information to make adjustments
4. Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions
5. Document the process

STEP 5.1.1	System Level: Determine monitoring framework
Description	

Figure 5-4: Strategic Monitoring
Source: Federal Highway Administration



The first step toward establishing a monitoring framework is to define what metrics are to be tracked, the frequency, and data sources. In addition, it is important to identify who needs to see the monitoring information—for what purpose and in what form? Monitoring efforts should take place regularly, with data collection and management ongoing, as discussed further in Components C and D. Developing a strategy for efficient monitoring and adjustment involves balancing the need for frequent information updates within the constraints of resource efficiency. Setting monitoring frequency should be done such that information is produced often enough to capture change. It should not be done so frequently that it creates extra unnecessary work, and not so infrequently that it misses early warning signs. Striking the right reporting frequency balance will take agencies time to figure out and will vary based on what is being monitored. Having the ability to vary monitoring frequency greatly enhances an agency's capacity not only to respond to internal and external requests, but also to identify necessary planning and programming adjustments.

The typical system level monitoring runs on a long-range timeframe; it can be monthly up to a

STEP 5.1.1	System Level: Determine monitoring framework
	multi-year basis. This is because gaining an understanding of the linkage between resource allocation decisions and system performance results can take several years. **Items to keep in mind as the monitoring framework is being developed:** • **Include at a minimum the performance measures used to assess progress toward strategic agency goals (Component 01)**. All elements of a transportation performance management approach need to connect back to the agency's strategic direction and performance targets. • **Coordinate with other agency business.** There will be opportunities to combine efforts with annual reports, plan updates, and other ongoing business processes. Efficiencies can be achieved by aligning with legislative or budgetary milestones. • **Expand monitoring capabilities through data partnerships.** The sharing of data internally across agency departments and with external partners can greatly enhance an agency's monitoring and adjustment capabilities. • **Identify data gaps.** Once the monitoring metrics have been determined, determine the suitability of the available data and existing gaps (see Data Usability and Analysis, Component D). As the monitoring process matures, data needs will likely need to expand to improve the understanding of the causes behind progress or lack thereof. • **Clarify how monitoring needs vary by user.** Identifying the range of monitoring-information users (e.g., performance analyst versus senior agency manager) will help determine the monitoring framework. (See Data Management, Component C). • **Establish close ties** to reporting and communications efforts (Component 06).
Example	Within **Utah DOT's** long-range transportation plan (LRTP), the agency assesses the attainment of each strategic goal. For example, under the goal of system preservation, the areas of pavement condition, bridge condition, and maintenance each have their own targets toward which plans and programs are strategized. UDOT has structured its monitoring framework such that an annual update, Strategic Direction 2015, requires monitoring checkpoints on performance measures and targets developed in the four-year LRP.[1] Below, the Maintenance Division at UDOT reports its targets as well as yearly progress toward them (Figure 5-5). Figure 5-6 shows a view of UDOT's Click 'n Fix Dashboard that staff uses to track daily maintenance requests. Staff can see the number of reported issues on a day to day basis, and the interface also allows monitoring via maps and reports regarding completed or incomplete requests. The key here is the linkage back to the agency's strategic goals and performance targets. UDOT integrates annual monitoring efforts into its LRTP process in order to assess progress on a systemic level, and then also monitors on a programmatic level to assess progress toward performance targets within specific program areas, such as system preservation. The monitoring framework is set up so that there are yearly updates within performance areas, as well as the ability to check in still more frequently via a project-tracking dashboard.

[1] Utah Department of Transportation. (2015). Strategic Direction 2015. Taylorsville, UT. https://www.udot.utah.gov/main/uconowner.gf?n=19974707633468335

STEP 5.1.1	System Level: Determine monitoring framework

Figure 5-5: MMQA Select Key Measurements: Projects Completed v. Targets

Source: Strategic Direction 2015[2]

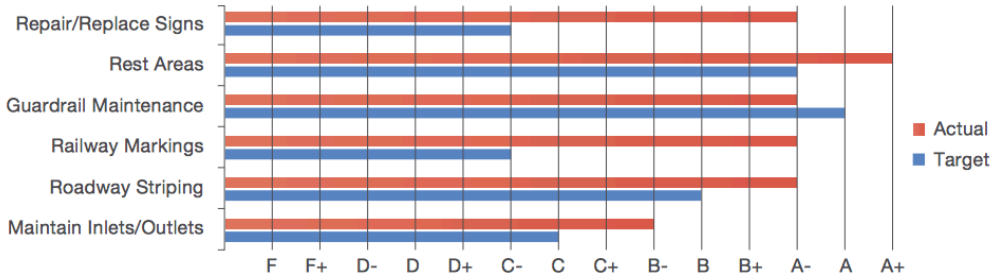
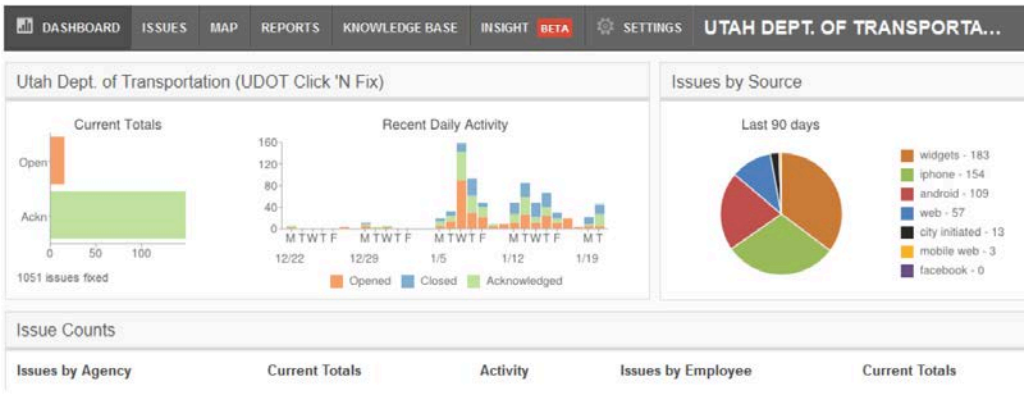


Figure 5-6: UDOT Click 'n Fix Dashboard

Source: Strategic Direction 2015[3]



Linkages to Other TPM Components	Component 01: Strategic Direction	(See TPM Framework)
	Component 02: Target Setting	
	Component 04: Performance-Based Programming	
	Component 06: Reporting and Communication	
	Component C: Data Management	
	Component D: Data Usability and Analysis	

STEP 5.1.2	System Level: Regularly assess monitoring results
Description	This step entails instituting a well-defined performance-monitoring process to understand past and current performance. At a minimum, an agency should review the performance trends for each measure developed under the Strategic Direction (Component 01). During this step, it is important to return to the internal and external factors at play that may have an impact on

[2] Utah Department of Transportation. (2015). Strategic Direction 2015. Taylorsville, UT. https://www.udot.utah.gov/main/uconowner.gf?n=19974707633468335

[3] Utah Department of Transportation. (2015). Strategic Direction 2015. Taylorsville, UT. https://www.udot.utah.gov/main/uconowner.gf?n=19974707633468335

STEP 5.1.2	System Level: Regularly assess monitoring results

progress toward a goal. Factors might include ongoing public input, a shift in priorities, or a change in any of the many external or internal factors that might potentially impact the agency's work (see Table 5-4 below). If ongoing monitoring reveals that an agency is falling short of a performance target, this might indicate that the target was not realistic, the strategies were not effective, or one factor or a combination of factors threw performance results off course. In this step, conduct performance diagnostics to understand system performance trends.

Table 5-4: Review of Potential Influencing Factors

Source: Federal Highway Administration

Internal	External
Funding	Economy
Staffing constraints	Weather
Data availability and quality	Politics/legislative requirements
Leadership	Population growth
Capital project commitments	Demographic shifts
Planned operational activities	Vehicle characteristics
Cultural barriers	Zones of disadvantaged populations
Agency priorities	Vehicle characteristics
Agency jurisdiction	Modal shares
Senior management directives	Gas prices
Policy directives (e.g., zero fatalities)	Land use characteristics
Cross performance area tradeoffs	Driver behavior
Collaboration across agency	Traffic

Below is a set of questions that can be used to start the performance diagnosis. While the specific questions will depend on the specific performance area, the following types of questions will generally be applicable:

- What is the current level of performance?
  - How does it vary across different types of related measures (e.g., pavement roughness, rutting, and cracking)?
  - How does it vary across different transportation system subsets (e.g., based on district, jurisdiction, functional class, ownership, corridor, etc.)?
  - How does it vary by class of traveler (e.g., mode, vehicle type, trip type, age category, etc.)?
  - How does it vary by season, time of day, or day of the week?
- Is observed performance representative of "typical" conditions or is it related to unusual events or circumstances (e.g., storm events or holidays)?
- How does our performance compare to others?
  - How does it compare to the national average?

STEP 5.1.2	System Level: Regularly assess monitoring results
	○ How does it compare to peer agencies? • How does the current level of performance compare to past trends? ○ Are things stable, improving or getting worse? ○ Is the current performance part of a regular occurring cycle? • What factors have contributed to the current performance? ○ What factors can we influence (e.g., hazardous curves, bottlenecks, pavement mix types, etc.)? ○ How do changes in performance relate to general socio-economic or travel trends (e.g., economic downturn, aging population, lower fuel prices contributing to increase in driving)? • How effective have our past actions to improve performance been (e.g., safety improvements, asset preventive maintenance programs, incident response improvement, etc.)?
Example	The **Regional Transportation Commission (RTC)** is the metropolitan planning organization (MPO) for Southern Nevada, including the Las Vegas Valley, and is tasked with identifying programs and projects to improve air quality, provide mobility options, and enhance transportation efficiency and safety. In monitoring how effective RTC strategies are in making progress toward the region's nine goals, a key external factor RTC must consider is the fact that Southern Nevada continues to grow rapidly in terms of economy and population. This increases demands on the transportation system as a whole, while also compounding the complexities of funding it. While the recession impacted funding levels, it only slowed rather than stopped area growth, leading to an increased mismatch between available transportation financing and system needs.[4] As a result of the potential impacts from these external factors, RTC has utilized a model to estimate regional economic and population growth developed by the University of Nevada Las Vegas's Center for Business and Economic Research. RTC coordinated the use of this model by local jurisdictions in the region, so that RTC can better predict travel demand, congestion increases, and air quality impacts[5] and hence better understand the outcomes of their strategies and how the system is serving customers. By monitoring the demands on the system as well as its outcomes, RTC is better able to assess the financial needs for meeting those demands. As a result of the uncertainties caused by the rate of growth in the area and accompanying financial model complexity, RTC includes many "unfunded needs" projects in its program to reflect and track unmet needs over the course of the plan period. RTC recognizes how important external influences are in understanding the region's ability to make progress toward its goals and objectives.

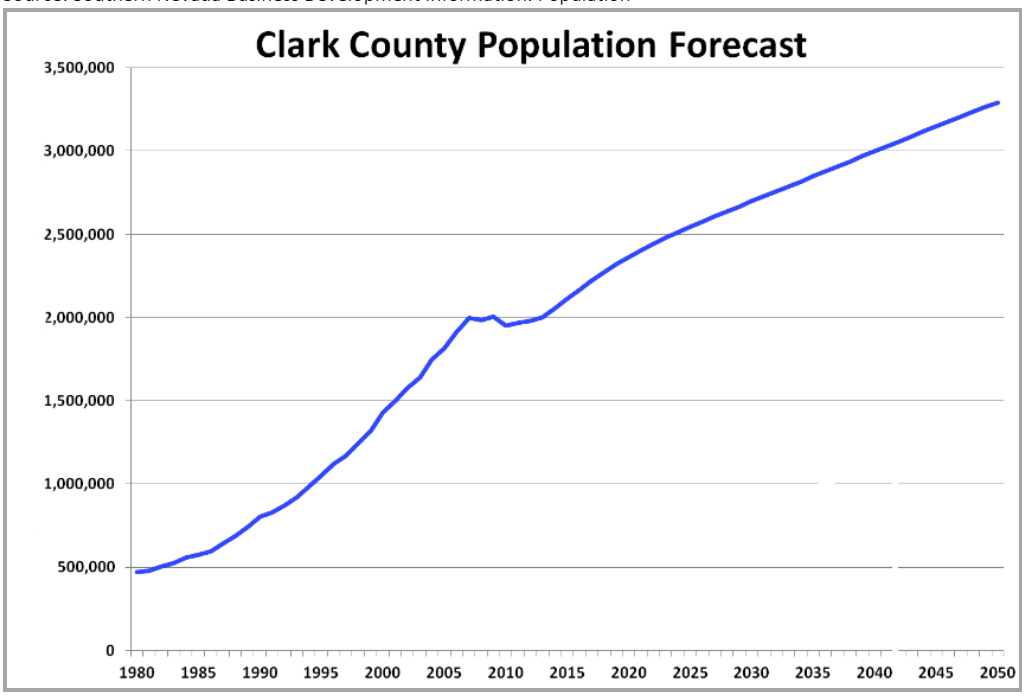
[4] Regional Transportation Commission of Southern Nevada. (2012). Regional Transportation Plan, 2013-2035, p. 36. http://www.rtcsnv.com/wp-content/uploads/2012/10/Final_RTP-2013-35-Redetermination-0214131.pdf

[5] Regional Transportation Commission of Southern Nevada. (2012). Regional Transportation Plan, 2013-2035, p. 41. http://www.rtcsnv.com/wp-content/uploads/2012/10/Final_RTP-2013-35-Redetermination-0214131.pdf

STEP 5.1.2	System Level: Regularly assess monitoring results

Figure 5-7: Clark County Population Growth Projection through 2050

Source: Southern Nevada Business Development Information: Population[6]



Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework) Component 02: Target Setting Component C: Data Management Component D: Data Usability and Analysis

STEP 5.1.3	System Level: Use monitoring information to make adjustments

Description

With a better understanding of past and current performance, agencies can isolate what causal factors they can influence and act on these new insights.

Items to keep in mind as monitoring information is used to consider adjustments:

- **Passage of time.** Has enough time passed to gain a true picture of progress? The trajectory of progress is not always a straight-line movement; more data points may be necessary to fully understand the trend. Often, momentum can build or can be impacted by external factors over the measurement timeframe.
- **Constraints.** Agencies may be hindered from making program and project adjustments by TIP and RTP amendment cycles, budget development timeline, legislative requirements (e.g., delivery of conformity model runs).
- **Anomalies.** Consider whether there were special circumstances driving the performance results. A single event or factor can have a sizable impact, so something

[6] University of Nevada Las Vegas, Center for Business and Economic Research. (2016). Clark County Population Forecast. Las Vegas, NV. http://cber.unlv.edu/charts/Clark%20County%20Population%20Forecast.pdf

STEP 5.1.3	System Level: Use monitoring information to make adjustments

atypical occurring, such as a natural disaster or unexpected funding change, can lead to erroneous conclusions if not adequately understood.

- **Reliability of predicted performance improvements from adjustment.** Before implementing any adjustments, agencies should analyze future performance. In general, predictive capabilities should allow agencies to compare the "do nothing" scenario versus the potential impacts of adjustment (see Data Usability and Analysis, Component D).
- **"Sub-measures" that provide new insights into causal factors contributing to performance.** A sub-measure is a detailed quantifiable indicator uncovered during monitoring that provides additional insights into internal and external processes (e.g., preventive maintenance compliance—a driver of overall asset performance).

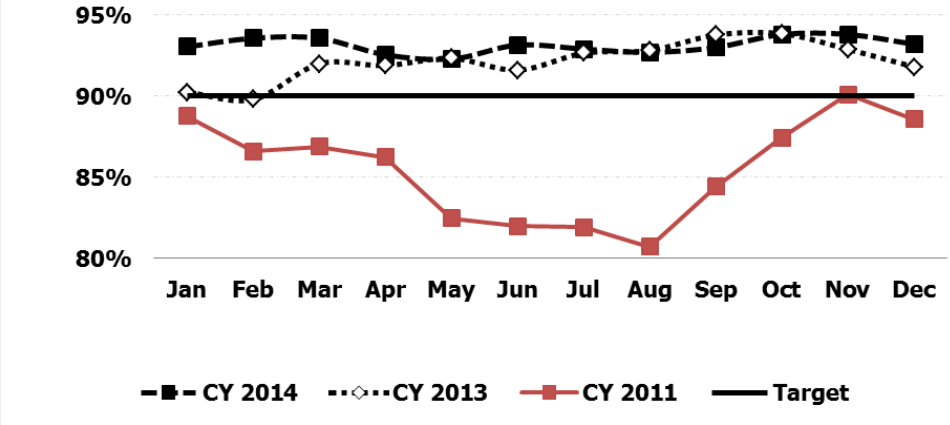
After these considerations, determine whether course correction is necessary. A communications strategy should be in place to ensure that stakeholders are informed and up to date on monitoring results and their consequences. If changes are made, be sure that any new measures, goals, or targets are calibrated to the preceding ones to ensure continuity and comprehensible documentation.

Example

At the Washington Metropolitan Area Transit Authority (WMATA), escalator availability is a top priority of the agency's customers. In 2011, the agency was suffering from very low escalator availability (Figure 5-8):

Figure 5-8: Escalator System Availability

Source: Adapted from Vital Signs Report: 2014 Annual Results[7]



Agency staff conducted a range of performance diagnostics to try and uncover the root cause of the dismal performance results. The analysis discovered a preventive maintenance compliance rate of 44%. Quickly this new sub-measure was regularly tracked and discussed during executive management meetings. WMATA put increased emphasis on preventive maintenance, conducting more proactive inspections to identify issues before problems occurred, concentrating on mechanic training, expanding quality control inspections before escalators were returned to service, and realigning maintenance staff into geographic regions designed to improve response times. The result was a notable increase in preventive maintenance compliance and improved escalator availability.

[7] Washington Metropolitan Area Transit Authority. (2014). Vital Signs Report: A Scorecard of Metro's Key Performance Indicators 2014 Annual Results. Washington, DC. http://www.wmata.com/about_metro/docs/Vital_Signs_Report_Q4_2014.pdf

STEP 5.1.3	System Level: Use monitoring information to make adjustments
Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework) Component 02: Target Setting Component A: Organization and Culture Component C: Data Management Component D: Data Usability and Analysis

STEP 5.1.4	System Level: Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions
Description	This step creates the critical feedback loop between performance results and future planning, programming and target setting decisions. To create an effective feedback loop, the monitoring information and the effect of adjustments need to be integrated into future strategic direction development (Component 01) and the setting of performance targets (Component 02). Through an increased understanding of the linkage between resource allocation decisions and results, the monitoring and adjustment component uncovers information to be used in future planning (Component 03) and programming (Component 04) decisions. This component also helps agency staff link their day-to-day activities to results and ultimately agency goals (Organization and Culture, Component A). The external and internal reporting and communication products (Component 06) need to be based on the information gathered during monitoring and adjustment.  **Figure 5-9: Feedback Loop** Source: Federal Highway Administration
Example	A serious snow-related congestion event on February 9, 2014 on Colorado Interstate 70 turned a two-hour drive on I-70 into an eight-to 10-hour journey.[8] This event became a catalyst for the **Colorado Department of Transportation (CDOT)** to reexamine its maintenance and operations practices on this busy corridor. CDOT also engaged in an extensive monitoring of the corridor's mobility and safety results. **Because of this, the agency determined that the current level of performance on the corridor was not acceptable and made the following adjustments:** • **Infrastructure.** Colorado DOT widened the east and westbound Twin Tunnels, the first improvements along the corridor in 40 years. • **Operations.** Colorado DOT invested $8 million to implement strategies such as additional plow drivers, snowplow escorts on the Eisenhower Tunnel approach, and ramp traffic metering at key locations. • **Public Education.** Colorado DOT launched a public education campaign, Change Your Peak Drive, and worked with partners and other stakeholders to educate the public

[8] Whaley, Monte, "CDOT Tackling I-70 Mountain Corridor," The Denver Post, April 6, 2014. http://www.denverpost.com/news/ci_25504609/cdot-tackling-i-70-mountain-corridor

STEP 5.1.4	System Level: Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions

on driver behavior issues such as having good tires, driving safely around plows, traveling during off-peak times, and finding information such as broadcasted radio updates, and carpooling.[9]

The Division of Highway Maintenance was also given an elevated leadership role in coordinating capital and annual maintenance. It received additional staff support to accomplish this, with Directors of Operations assigned to each corridor, and maintenance crews and equipment pledged from other areas of the state for the winter. Additionally, in order to make the improvements real to the public, assist in monitoring efforts, and measure outcomes of this shift, Maintenance and Operations leadership began developing milestones and metrics around new objectives related to improved mobility on I-70 and I-25. This was assisted by departmental efforts to improve data gathering efforts and provide more accurate time measurements for closures, delays, and causes of delay.[10]

Aligned with this systemic shift, the improvements to I-70 are specifically called out in the January 9, 2015 *Action Plan* for implementation and are further discussed below.[11] In addition, a key mobility goal within the Strategic Actions developed for the Statewide Plan specifically calls for the development of Regional Operations Implementation Plans, Corridor Operations Plans, and tools to focus resources and solve issues at the regional and corridor levels.[12]

In June 2015, Colorado DOT revealed the performance improvements that had occurred as a result of these efforts over the course of Winter 2015, demonstrated by before and after mobility and safety measurements on I-70. The agency found that injuries and fatal crashes were reduced by 35%, and weather-related crashes were reduced by 46%. Unplanned closure time decreased by 16%; the number of hours of eastbound delay greater than 75 minutes was decreased by 26%.[13] Further efforts will continue to be developed, such as training for corridor first responders, defining performance measures for traffic incident clearance, and establishing a schedule of routine incident debriefings and performance assessments.[14] COtrip, an online interface offering live camera monitoring, incident monitoring, and real time road conditions was launched to assist in communicating conditions to users as well as aid monitoring efforts.

[9] Colorado Department of Transportation, "CDOT Improvements to I-70, Paired with Driver Awareness, Reduced Crashes and Delays This Winter," June 29, 2015. https://www.codot.gov/news/2015-news-releases/06-2015/cdot-improvements-to-i-70-paired-with-driver-awareness-reduced-crashes-and-delays-this-winter

[10] Scott Richrath, Email to Trish Hendren, May 18, 2015.

[11] http://coloradotransportationmatters.com/wp-content/uploads/2015/03/CDOT_Action_Plan.pdf

[12] Colorado Department of Transportation. Strategic Actions for the Statewide Plan. http://coloradotransportationmatters.com/wp-content/uploads/2015/03/CDOT_ES_TopStrategicActions_3-16-15.pdf.

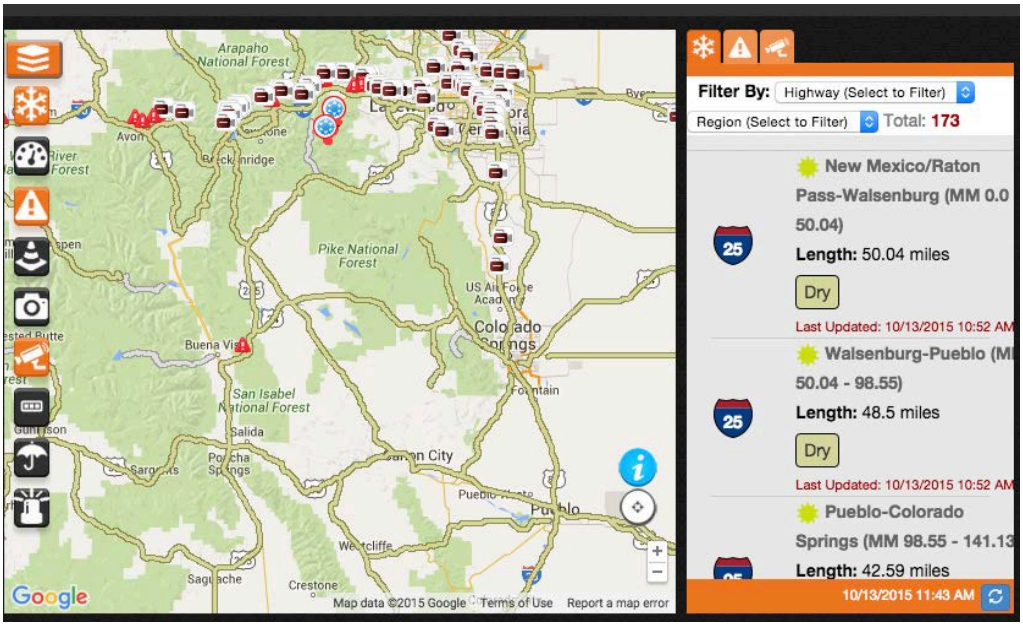
[13] https://www.codot.gov/news/2015-news-releases/06-2015/cdot-improvements-to-i-70-paired-with-driver-awareness-reduced-crashes-and-delays-this-winter

[14] https://www.codot.gov/travel/winter-driving/I-70WestTrafficMgmt.html

STEP 5.1.4	System Level: Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions

Figure 5-10: CO Trip User Interface

Source: Colorado Department of Transportation[15]



Colorado DOT's actions on I-70 illustrates actions taken to adjust targets, prioritize projects, and allocate resources after the February 2014 serious weather and congestion event caused delays that impacted mobility performance to an unacceptable degree. This has been documented and incorporated into priorities for Colorado DOT's upcoming update to its Statewide Transportation Plan. Moving forward, monitoring of performance on these corridors will reveal any change in outcomes due to this shift in operations and resources, or may reveal further opportunities for improvement.

Linkages to Other TPM Components

Component 01: Strategic Direction (See TPM Framework)

Component 02: Target Setting

Component 03: Performance-Based Planning

Component 04: Performance-Based Programming

Component 06: Reporting and Communication

Component A: Organization and Culture

Component C: Data Management

Component D: Data Usability and Analysis

[15] Colorado Department of Transportation - COtrip Road Map. June 2, 2016. http://cotrip.org/map.htm#/roadWork

STEP 5.1.5	System Level: Document the process
Description	Document the process, including progress, outputs, outcomes, and any strategic adjustments and the reasoning behind these. This includes documentation for the purposes of internal operations, ensuring that the monitoring and adjustment process is replicable in future iterations of plans and throughout multiple planning efforts. It also includes steps toward gathering and organizing data (see Components C and D) in order to ensure that external reporting (Component 06) can be carried out in a sustainable and impactful way.
Examples	Several examples are offered here to illustrate how strategic level monitoring and adjustment processes and any subsequent changes to goals and targets are documented. **Program Delivery Monitoring at Southwestern Pennsylvania Commission** The Southwestern Pennsylvania Commission (SPC) offers a large amount of documentation regarding each individual program area's monitoring and adjustment processes. As an example, within its congestion management program, SPC implements strategies under divisions of demand management, modal options, operational improvements, and capacity improvements. SPC documents all of the performance measurements and associated monitoring calculations directly on its website. [16] Gathered here are all the associated studies, reports, and other tools SPC uses to highlight, analyze, and evaluate the effectiveness of various congestion management strategies implemented.[17] As an example within this program, HOV lanes are listed as one strategy implemented to help reach congestion goals in the SPC region. SPC documents the reasoning behind the strategy and its relationship to the agency's congestion targets. Before and after analysis is completed using results from monitoring traffic delay, and detailed information is included as to how calculations were reached and compared. This ensures that the same monitoring process can be reproduced indefinitely, allowing ongoing understanding of how investment in HOV lanes has enabled SPC to progress toward its congestion reduction target and its mobility goals.[18] **Program Delivery Monitoring at Missouri DOT** In the last decade, faced with increasing costs and decreasing revenue streams, the Missouri Department of Transportation (MoDOT) revisited its pavement management program. Based on financial constraints, the agency decided to focus its efforts on improving major highways, rather than spreading resources out over minor roads as well, as had been done according to a past formula. MoDOT established a target that would benefit the most users per dollar spent and relaxed its target for overall pavement condition that included minor roads. As a result of this adjustment, fewer resources were allocated to the preservation of minor roads, and the percentage of minor roads in good condition decreased from 71% to 60% from 2005 to 2009.[19] At the same time, however, MoDOT was able to respond to customers' desires for

[16] Southwestern Pennsylvania Commission, "Congestion Management Process: Performance Measures," http://www.spcregion.org/trans_cong_pm.shtml
[17] Southwestern Pennsylvania Commission, "Congestion Management Process: Strategy Implementation and Monitoring Effectiveness," http://www.spcregion.org/trans_cong_mon.shtml
[18] http://www.spcregion.org/pdf/cmpdoc/Operational%20Improvements/ParkwayNorth_HOVAnalysis_April2008.pdf
[19] Missouri Department of Transportation. (October 2014). *Tracker: Measures of Departmental Performance,* "Keep Roads and Bridges in Good Condition," 2a.

STEP 5.1.5	System Level: Document the process
	smoother roads by significantly improving the condition of major routes, from 47% in 2004 to 85% in 2007. Currently over 89% of major highways are in good condition, but MoDOT recognized that this condition level would be difficult to maintain without additional resources.[20] MoDOT used its Tracker performance measurement tool to document this adjustment to its performance targets and measures, and to monitor and report the results, which are released quarterly. Documenting the decision to focus more resources on major routes rather than on the system overall was key to MoDOT's ability to measure progress moving forward and also to ensure stakeholders understood the adjustment. MoDOT measures its progress not only with typical performance measures, but also through regular customer satisfaction surveys and focus groups to determine whether improvement projects are making the anticipated progress toward a satisfactory user experience—therefore communicating this strategy back to users using monitoring data was critical.[21] This documentation shows how the programs and projects implemented as MoDOT's pavement strategies are intended to impact progress toward performance targets.
Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework) Component 02: Target Setting Component 03: Performance-Based Planning Component 04: Performance-Based Programming Component 06: Reporting and Communication Component C: Data Management Component D: Data Usability and Analysis

[20] Missouri Department of Transportation. (October 2014). *Tracker: Measures of Departmental Performance,* "Keep Roads and Bridges in Good Condition," 2a.
[21] National Cooperative Highway Research Program. (2010). *Transportation Performance Management: Insight from Practitioners*. NCHRP Report 660, 35. Washington, DC. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf

5.2 PROGRAM/PROJECT LEVEL

The purpose of this subcomponent is to establish a process for tracking program and project outputs, and the effect of programs and projects on performance outcomes. This process provides early warning of potential inability to achieve performance targets. Insights are used to make project or program "mid-stream" adjustments and guide future programming decisions. The following section outlines steps agencies can follow to establish program/project level monitoring and adjustment processes. While the step names are identical, descriptions of monitoring activities within each step vary.

1. Determine monitoring framework
2. Regularly assess monitoring results
3. Use monitoring information to make adjustments
4. Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions
5. Document the process

> "A performance-based approach shifts the focus off of 'can we deliver the project on budget' to 'are we doing the right set of projects.' Monitoring and adjustment processes help us understand project results – information that is key to picking an effective set of projects year after year to maximize taxpayer investment into the system by focusing on projects that truly drive a better and safer outcome."
>
> - Greg Slater, MD State Highway Administration

STEP 5.2.1	Program/Project Level: Determine monitoring framework
Description	

Figure 5-11: Strategic Monitoring
Source: Federal Highway Administration

The first step toward establishing a monitoring framework is to define what metrics are to be tracked, the frequency, and data sources. In addition, it is important it identify who needs to see the monitoring information—for what purpose and in what form. Monitoring efforts should take place regularly, with data collection and management ongoing, as discussed further in Components C and D. Developing a strategy for efficient monitoring and adjustment involves balancing the need for frequent information updates within the constraints of resource efficiency. Monitoring frequency should produce information often enough to capture change, yet not so frequently that it creates extra unnecessary work, and not so infrequently that it misses early warning signs. Striking the right reporting frequency balance will take time to figure out and will vary based on what is being monitored. Having the ability to vary monitoring frequency will greatly enhance an agency's capacity not only to respond to internal and external requests, but also to identify necessary planning and programming adjustments.

The typical program/project level monitoring ranges from 'up-to-the-minute' to a yearly basis. To assess the effectiveness of programs and projects, annual updates should occur at a minimum, with regular internal check-ins a must for understanding if projects are being delivered on time and within scope. However, gaining an understanding of the effect strategies are having on performance results may take longer.

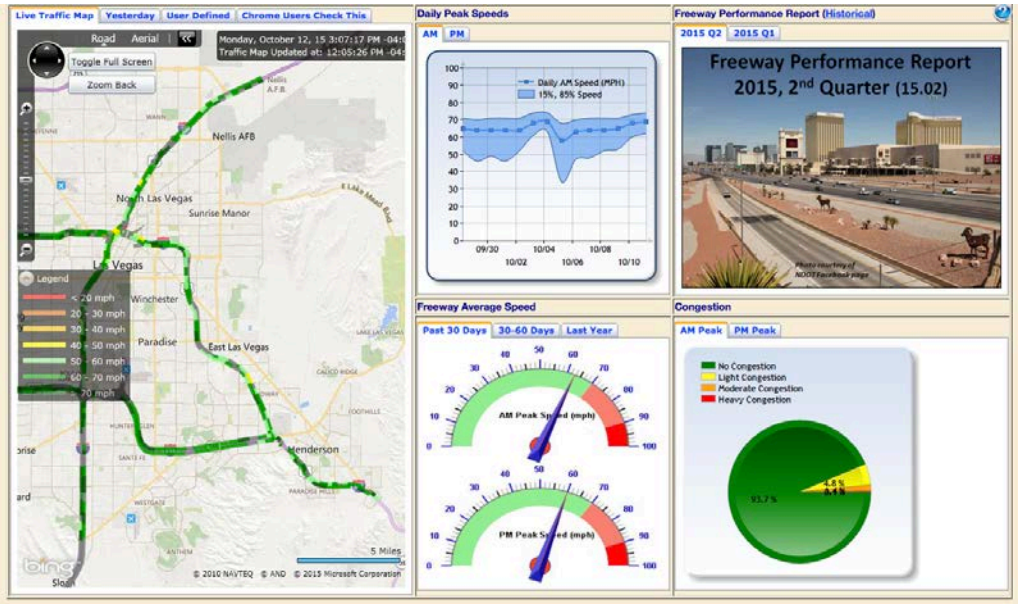
STEP 5.2.1	Program/Project Level: Determine monitoring framework
	Items to keep in mind as the monitoring framework is being developed: • **Link metrics used in monitoring to strategic direction.** All elements of a transportation performance management approach need to connect back to the agency's strategic direction and performance targets. • **Coordinate with other agency business.** There will be opportunities to combine efforts with annual reports, plan updates, and other ongoing business processes. Efficiencies can be achieved by aligning with legislative or budgetary milestones. • **Expand monitoring capabilities through data partnerships.** The sharing of data internally across agency departments and with external partners can greatly enhance an agency's monitoring and adjustment capabilities. • **Identify data gaps.** Once the monitoring metrics have been determined, determine the suitability of the available data and existing gaps (see Data Usability and Analysis, Component D). As the monitoring process matures, data needs will likely need to expand to improve the understanding of the causes behind progress or lack thereof. • **Clarify how monitoring needs vary by user.** Identifying the range of monitoring information users (e.g., performance analyst versus senior agency manager) will help determine the monitoring framework (see Data Management, Component C).
Example	The FAST system (**Freeway and Arterial System of Transportation**) is a comprehensive monitoring effort that develops, implements, and maintains an Intelligent Transportation System (ITS) administered by the Regional Transportation Commission (RTC) in conjunction with the Nevada Department of Transportation (NDOT). Nevada's ITS includes coordinated traffic monitoring cameras, signal timing, and a portfolio of projects such as ramp metering and informative signage aimed at reducing congestion and improving user experience along major corridors throughout the region. Using FAST to monitor Southern Nevada's major corridors, RTC can devise mobility improvements without relying solely on system expansion, and can better prioritize the most impactful programs and projects based on performance measures.[22] FAST helps RTC define and track progress toward meeting performance targets, which ultimately defines specific project needs and impacts such as maintenance, critical missing links and capacity needs.[23] FAST is an award-winning real-time monitoring dashboard that enables detailed analysis on request.[24] The dashboard displays feeds from cameras to track congestion along the corridors. This interface is monitored by RTC staff to develop quarterly reports on congestion events and understand historic patterns. The system archives thousands of screen shots of traffic camera feeds every few seconds. This means that RTC staff can perform analysis immediately to understand the impacts of a particular event. A screenshot of the dashboard is shown below. A live map is available on the left hand side; average speeds analysis for the past 30 days is displayed in the middle; and the latest quarterly reports and a peak congestion index appear at the right. By signing in, users can perform historic analysis to determine what the impacts of a particular event or project might be, whether it is a parade, construction, or a serious crash.

[22] Regional Transportation Commission of Southern Nevada. (2012). Regional Transportation Plan, 2013-2035, p. 73.
[23] Regional Transportation Commission of Southern Nevada. (2012). Regional Transportation Plan, 2013-2035, p. 74.
[24] The FAST dashboard was recognized with a 2014 Data Innovation Challenge award for Traffic and Congestion Management by USDOT and a 2011 Institute of Transportation Engineers Achievement Award.

STEP 5.2.1	Program/Project Level: Determine monitoring framework

Figure 5-12: NDOT Coordinated Traffic Monitoring Interface

Source: RTC FAST Dashboard[25]



When an incident is detected by the ITS system, FAST operators flag the location on a live map, which automatically inputs temporal and spatial information about the incident and provides an area for an operator to input any additional data on the incident. Then, snapshots of the incident location as well as upstream and downstream locations are archived at 15-second intervals so that staff can have a visual reference and a timestamp for incident impacts and clearance rates.[26]

As an example, recent analysis of incidents on FAST revealed the impacts of large downtown conventions on the traffic patterns of Las Vegas's major corridors. Closely examining these patterns will enable RTC and partners in NDOT and the Metropolitan Police to better manage such large events and the traffic demands they entail. This includes the impact of police traffic direction, which assists by prioritizing access to and from event locations, but also contributes to corridor delays and beyond.

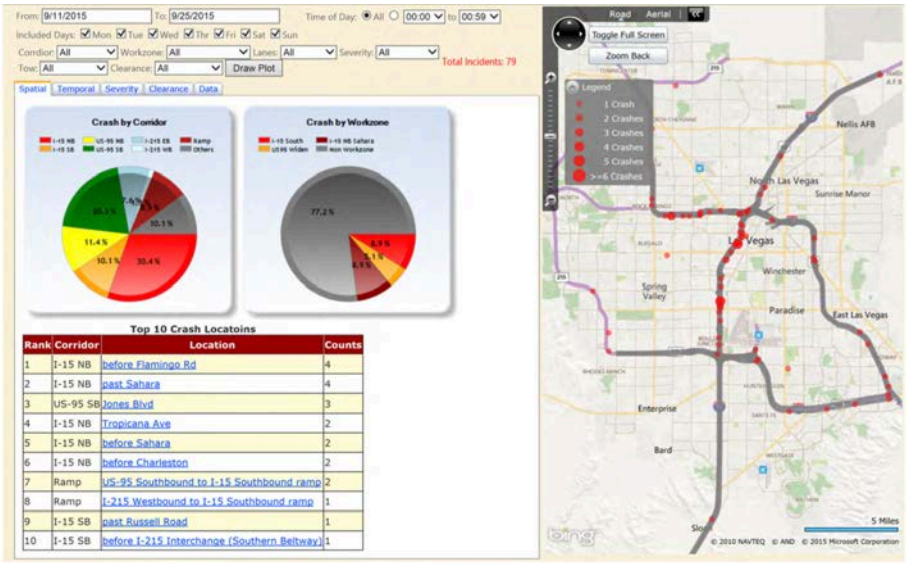
The detailed historic analysis enabled by FAST also shows congestion event and crash trends and helps RTC identify potential interventions. By providing historic performance data, FAST aided in making decisions, such as whether a full weekend closure or revolving weekday closures will cause less adverse effect when planning for a major construction project with NDOT. FAST can also pinpoint locations for safety interventions. When an expansion project on I-15 resulted in an increased number of crashes and delays, FAST pinpointed where restriping was needed to alleviate the issue. A snapshot of crash by corridor analysis is shown below.

[25] Nevada Department of Transportation - RTC FAST Dashboard. March 2, 2016. http://bugatti.nvfast.org/Default.aspx
[26] This information courtesy of Brian Hoeft, Director of FAST.

STEP 5.2.1	Program/Project Level: Determine monitoring framework

Figure 5-13: NDOT Coordinated Traffic Monitoring Congestion Analysis

Source: RTC FAST Camera Snapshot Wall [27]



FAST enables staff to determine location of, and then monitor the impacts of, smart fixes such as ramp metering, restriping, enhanced or interactive signage, and directly report progress toward RTC's congestion reduction and safety enhancement goals.

Linkages to Other TPM Components

Component 01: Strategic Direction (See TPM Framework)

Component 02: Target Setting

Component 04: Performance-Based Programming

Component C: Data Management

Component D: Data Usability and Analysis

STEP 5.2.2	Program/Project Level: Regularly assess monitoring results

Description

Using the monitoring framework, this step entails conducting performance diagnosis to determine root causes of the observed performance results (e.g., correlating traffic incidents with travel speed data; breaking down crash data by contributing factors recorded in crash records or highway inventories). Part of performance diagnosis means an examining and understanding of the factors impacting the effect programs and projects have on performance results. See below for a list of examples by TPM performance area (Table 5-4). If ongoing monitoring reveals that an agency is falling short of a performance target, this might indicate that the target was not realistic, the strategies were not effective, or one factor or a combination of factors threw performance results off course. In this step, analyze before and after performance results, in order to make a diagnosis.

[27] Nevada Department of Transportation - RTC FAST Dashboard. March 2, 2016. http://bugatti.nvfast.org/Default.aspx

STEP 5.2.2	Program/Project Level: Regularly assess monitoring results

Table 5-5: Explanatory Variables by Performance Area

Source: Federal Highway Administration

TPM Area	Explanatory Variables
General	Socio-economic and travel trends
Bridge Condition	Structure type and design Structure age Structure maintenance history Waterway adequacy Traffic loading Environment (e.g., salt spray exposure)
Pavement Condition	Pavement type and design Pavement age Pavement maintenance history Environmental factors (e.g., freeze-thaw cycles) Traffic loading
Safety	Population Traffic volume and vehicle type mix Weather (e.g., slippery surface, poor visibility) Enforcement Activities (e.g., seat belts, speeding, vehicle inspection) Roadway capacity and geometrics (e.g., curves, shoulder drop off) Safety hardware (barriers, signage, lighting, etc.) Speed limits Availability of emergency medical facilities and services
Air Quality	Stationary source emissions Weather patterns Land use/density Modal split Automobile occupancy Traffic volumes Travel speeds Vehicle fleet characteristics Vehicle emissions standards Vehicle inspection programs
Freight	Business climate/growth patterns Modal options – cost, travel time, reliability Intermodal facilities Shipment patterns/Commodity flows Border crossings State regulations Global trends (e.g., containerization)
System Performance	Capacity Alternative routes and modes Traveler information Signal operations/traffic management systems

STEP 5.2.2	Program/Project Level: Regularly assess monitoring results

Demand patterns
Incidents
Weather
Special Events

Below are a set of questions that can be used to start the performance diagnosis. While the specific questions will depend on the performance area you are looking at, the following types of questions will generally be applicable:

- What outputs have been produced as a result of the examined program or project (e.g., the miles of pavement repaved, the number of bridges rehabilitated, the number of new buses purchased)?
- What is the current level of performance?
- Is observed performance representative of "typical" conditions or is it related to unusual events or circumstances (e.g., storm events or holidays)?
- How does the current level of performance compare to past trends?
  - Are things stable, improving or getting worse?
  - Is the current performance part of a regular occurring cycle?
- What factors have contributed to the current performance?
  - What factors can we influence (e.g., hazardous curves, bottlenecks, pavement mix types, etc.)?
  - How do changes in performance relate to general socio-economic or travel trends (e.g., economic downturn, aging population, lower fuel prices contributing to increase in driving)?
- How effective have our past actions to improve performance been (e.g., safety improvements, asset preventive maintenance programs, incident response improvement, etc.)?

Example

Monitoring Winter Maintenance Practices: Rhode Island

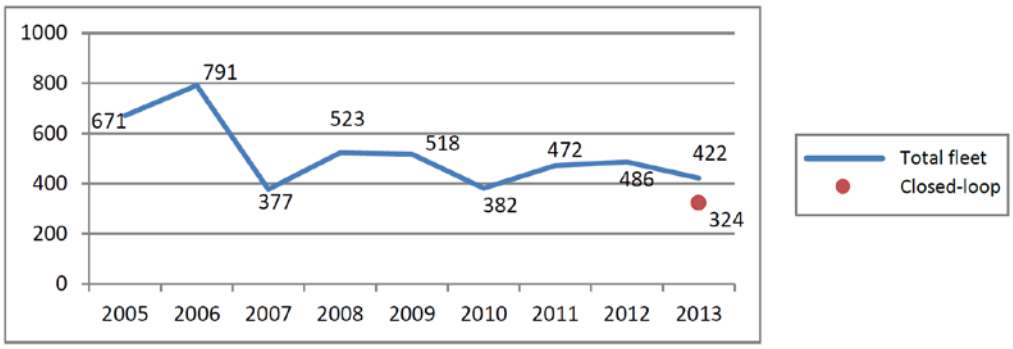
The Rhode Island Department of Transportation (RiDOT) is committed to reducing winter costs and alleviating environmental concerns related to its winter maintenance practices. In monitoring winter maintenance spending, RIDOT discovered a key driver of increasing costs was the use of salt products to treat roadways during winter storms. A potential solution, the installation of "closed-loop" systems in state-owned snowplows, was proposed by RIDOT staff. Closed-loop controllers provide more uniform salt and sand application and computerized data tracking resulting in reduction in material usage as compared to conventional spreaders. Closed-loop controllers would also enable RIDOT personnel to track material usage and application rates in specific locations.

RIDOT staff used the historical analysis of cost-drivers of the winter maintenance program and predicted savings from the closed-loop module to convince the budget office to let the agency use future savings to covert a portion of the winter vehicles to a "closed-loop" system. Once 20-30 percent cost savings was observed from lower salt usage (see figure below), RIDOT staff gained approval to install the equipment on 100 percent of the fleet. The understanding of a key driver of winter maintenance costs has allowed RIDOT to drive down roadway salt

STEP 5.2.2	Program/Project Level: Regularly assess monitoring results

application by more than 27 percent over the past seven years.[28]

Figure 5-14: RiDOT Winter Fleet: Average Pounds of Salt Per Lane Mile
Source: RiDOT Performance Report [29]



Linkages to Other TPM Components	Component 01: Strategic Direction	(See TPM Framework)
	Component 02: Target Setting	
	Component C: Data Management	
	Component D: Data Usability and Analysis	

STEP 5.2.3	Program/Project Level: Use monitoring information to make adjustments

Description

This step highlights the importance of actively using monitoring information to obtain key insights into the effectiveness of programs and projects and identify where adjustments need to be made.

Items to keep in mind as monitoring information is used to consider adjustments:

- **Passage of time.** Has enough time passed to gain a true picture of progress? The trajectory of progress is not always a straight-line movement; more data points may be necessary to fully understand the trend. Often, momentum can build or can be impacted by external factors over the measurement timeframe.
- **Constraints.** Agencies may be hindered from making program and project adjustments by TIP and RTP amendment cycles, budget development timeline, and legislative requirements (e.g., delivery of conformity model runs).
- **Anomalies.** Consider whether there were special circumstances driving the performance results. A single event or factor can have a sizable impact; if something atypical occurred such as a natural disaster or unexpected funding change, attempt to fully understand potential impacts to avoid making erroneous conclusions.
- **Reliability of predicted performance improvements from adjustment.** Before implementing any adjustments, agencies should analyze future performance. In general, predictive capabilities should allow agencies to compare the "do nothing"

[28] Statewide Planning Technical Paper Number: #000. Road Salt/Sand Application in Rhode Island. http://www.planning.ri.gov/documents/LU/RoadSaltTechPaper2013_12114rev.pdf
[29] Rhode Island Department of Transportation. (2013). Transportation Budget Fiscal Year 2013. Providence, RI. http://www.omb.ri.gov/documents/performance/performance-reports/all/1_Transportation_March%202013.pdf

STEP 5.2.3	Program/Project Level: Use monitoring information to make adjustments

scenario versus the potential impacts of adjustment (see Data Usability and Analysis, Component D)

After these considerations, determine whether a course correction is necessary. A communications strategy should be in place to ensure that stakeholders are informed and up to date on monitoring results and their consequences. If there are any changes, be sure that any new measures, goals, or targets are calibrated to the preceding ones to ensure continuity and understandable documentation.

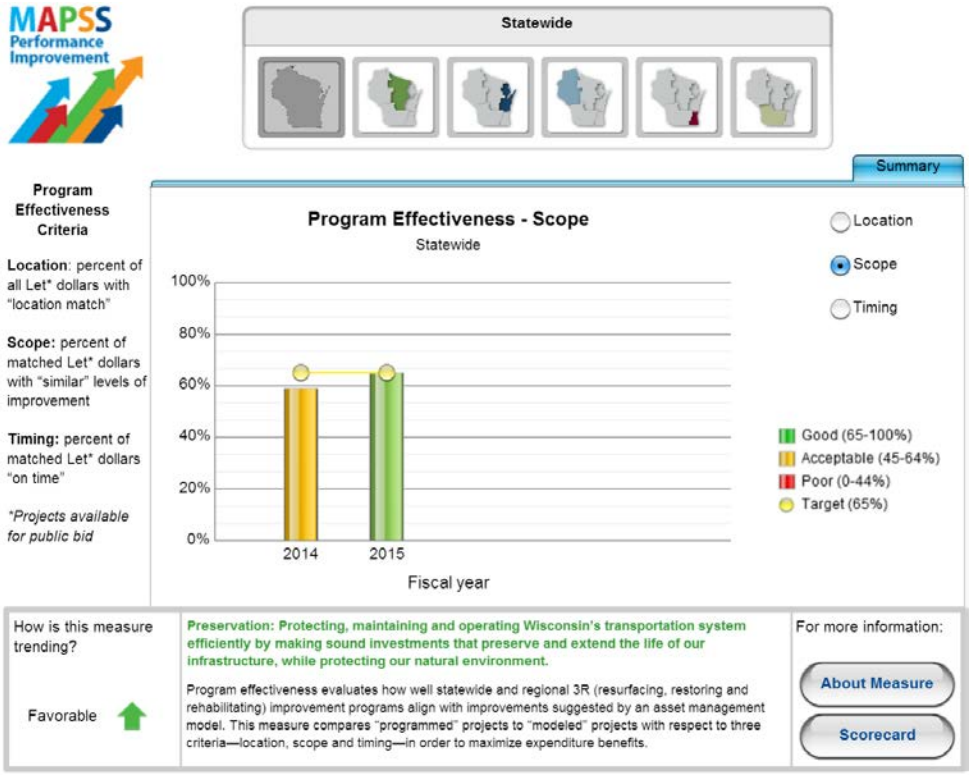
Example

Program Effectiveness Measure: WisDOT

The Wisconsin DOT uses a measure called Program Effectiveness to assess how improvement programs align with the agency's asset management model and performance-based plans. The measure is reported annually, and can be broken down into regions of the state and by location, scope, and timing of projects in reference to the model. Levels of performance are clearly indicated by color in the chart.[30]

Figure 5-15: WisDOT Regional Performance Effectiveness Scoring

Source: WisDOT [31]



[30] Wisconsin Department of Transportation - Program effectiveness. June 2, 2016. http://wisconsindot.gov/Pages/about-wisdot/performance/mapss/measures/preservation/program-effectiveness.aspx

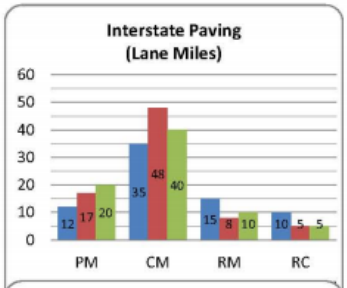
[31] Wisconsin Department of Transportation - Program effectiveness. June 2, 2016. http://wisconsindot.gov/Pages/about-wisdot/performance/mapss/measures/preservation/program-effectiveness.aspx

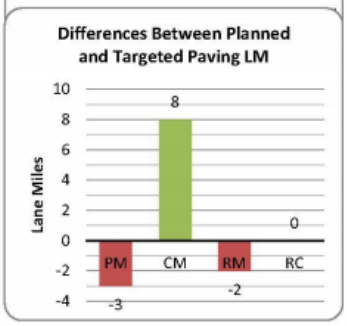
STEP 5.2.3	Program/Project Level: Use monitoring information to make adjustments

Pavement Management Adjustments: Virginia DOT

Virginia DOT (VDOT) uses a commercial Pavement Management System (PMS) with a companion pavement maintenance scheduling system tool (PMSS) to provide early warning of target non-attainment. This analysis is based on the status of planned paving projects, with the most recent pavement condition assessments and predicted pavement deterioration based on PMS performance models. The figure below illustrates one of the reports used to summarize planned versus targeted work by highway system class and treatment type. VDOT tracks project delivery and results on a statewide and district level. If issues are identified, VDOT makes adjustments to get back on track with predicted network-level pavement performance.

Figure 5-16: VDOT Pavement Maintenance Scheduling System Tool (PMSS)
Source: VDOT [32]





Hampton Roads Interstate Paving Summary

Preventative Maintenance (PM)	
2011 Awarded (PMSS):	16 LM
2012 Planned (PMSS):	17 LM
2012 Targeted (PMS Optimized):	20 LM
Difference (Planned – Targeted):	**-3 LM**
Corrective Maintenance (CM)	
2011 Awarded (PMSS):	35 LM
2012 Planned (PMSS):	48 LM
2012 Targeted (PMS Optimized):	40 LM
Difference (Planned – Targeted):	**+8 LM**
Restorative Maintenance (RM)	
2011 Awarded (PMSS):	15 LM
2012 Planned (PMSS):	8 LM
2012 Targeted (PMS Optimized):	10 LM
Difference (Planned – Targeted):	**-2 LM**
Reconstruction / Major Rehab (RC)	
2011 Awarded (PMSS):	10 LM
2012 Planned (PMSS):	7 LM
2012 Targeted (PMS Optimized):	7 LM
Difference (Planned – Targeted):	**0 LM**

Given planned 2012 Interstate paving, Hampton Roads District:
- **Is not** predicted to achieve its 20 lane mile paving target for Preventative Maintenance on the Interstate system.
- **Is** predicted to achieve its 40 lane mile paving target for Corrective Maintenance on the Interstate system.
- **Is not** predicted to achieve its 10 lane mile paving target for Restorative Maintenance on the Interstate system.
- **Is** predicted to achieve its 7 lane mile paving target for Reconstruction / Major Rehabilitation on the Interstate system.

Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework) Component 02: Target Setting Component A: Organization and Culture Component C: Data Management Component D: Data Usability and Analysis

[32] Virginia Department of Transportation. (2014). Use of VDOT's Pavement Management System to Proactively Plan and Monitor Pavement Maintenance and Rehabilitation Activities to Meet the Agency's Performance Target. Richmond, VA. https://vtechworks.lib.vt.edu/bitstream/handle/10919/56388/ICMPA9-000321.PDF?sequence=2&isAllowed=y

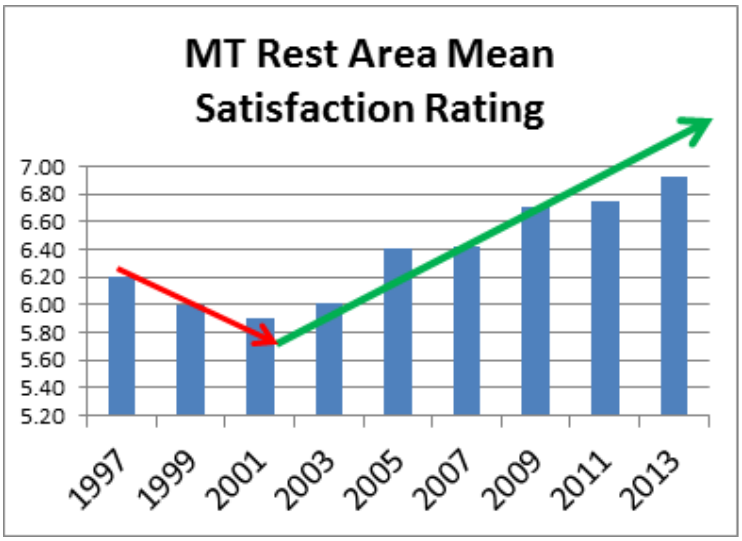
STEP 5.2.4	Program/Project Level: Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions
Description	This step creates the critical feedback loop between performance results and future planning, programming, and target setting decisions. To create an effective feedback loop, the monitoring information gathered and adjustments made to programs and projects need to be integrated into future strategic direction development (Component 01) and the setting of performance targets (Component 02). Through an increased understanding of the effect of specific projects and programs on outcomes, the monitoring and adjustment component uncovers information to be used in future planning (Component 03) and programming (Component 04) decisions. This component also helps agency staff link their day-to-day activities to results and ultimately agency goals (Organization and Culture, Component A). The external and internal reporting and communication products (Component 06) need to be based on the information gathered during monitoring and adjustment.  **Figure 5-17: Feedback Loop** Source: Federal Highway Administration
Example	As in other states, many of **Montana Department of Transportation's** (MDT) 49 state-maintained rest area facilities are at or nearing the end of their useful life, requiring substantial investment to remain operational. Though these facilities are expensive to build, operate, and maintain, the travelling public expects available, safe, clean rest stops. However, when rest area needs were placed side-by-side with roadways, these needs would often go unfunded, resulting in some rest areas being closed. To address this challenge, MDT established a rest area usage monitoring effort. For every facility in the state, MDT maintenance forces installed door counters ($250) at rest area entrances, installed potable water (non-irrigation) ($250) and wastewater (effluent flow meters) meters ($750) to create a time series data set and inform sound future investments. Usage determines all things – and reliable data means MDT could design and construct the right size facility, water supply, wastewater treatment system, parking lot, number of stalls, etc. MDT also better used and evaluated mainline traffic counts, especially permanent counters, to improve usage correlations to peak usage (time of year, time of day, etc.). The information gathered from these monitoring efforts and public complaints about rest areas triggered a series of rest area improvements being initiated even when competing with larger highway projects. The focused planning, investment, and research approach also created quantifiable project development and delivery efficiencies enabling MDT to do more with less. As customer satisfaction survey results reveal,[33] public perception and comments were very supportive of a rest area program grounded in monitoring and adjustment.

[33] Montana DOT. 2013 TranPlan 21 Public Involvement Survey: Volume 1 Final Report. https://www.mdt.mt.gov/publications/docs/surveys/2013_tranplan21_public_involvement.pdf

STEP 5.2.4	Program/Project Level: Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions

Figure 5-18: Rest Area Public Satisfaction 1997-2013

Source: TranPlanMT Public Involvement Surveys -2013[34]



Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework) Component 02: Target Setting Component 03: Performance-Based Planning Component 04: Performance-Based Programming Component 06: Reporting and Communication Component A: Organization and Culture Component C: Data Management Component D: Data Usability and Analysis

STEP 5.2.5	Program/Project Level: Document the process
Description	Document the process, including progress, outputs, outcomes, and any strategic adjustments and the reasoning behind these. This includes documentation for the purposes of internal operations, ensuring that the monitoring and adjustment process is replicable in future iterations of plans and throughout multiple planning efforts. It also includes steps toward gathering and organizing data (see Components C and D) in order to ensure that external reporting (Component 06) can be carried out in a sustainable and impactful way.

[34] Montana Department of Transportation. (2013). TranPlanMT Public Involvement Surveys -2013. Helena, MT. http://www.mdt.mt.gov/publications/surveys.shtml

STEP 5.2.5	Program/Project Level: Document the process

Examples

Several examples are offered here to illustrate how program/project level monitoring and adjustment processes and any subsequent changes to goals and targets are documented.

Program Delivery Monitoring at Southwestern Pennsylvania Commission (SPC)

SPC offers a large amount of documentation regarding each individual program area's monitoring and adjustment processes. As an example, within its congestion management program, SPC implements strategies under divisions of demand management, modal options, operational improvements, and capacity improvements. SPC documents all of the performance measurements and associated monitoring calculations directly on its website. [35] Gathered here are all the associated studies, reports, and other tools SPC uses to highlight, analyze, and evaluate the effectiveness of various congestion management strategies implemented.[36] As an example within this program, HOV lanes are listed as one strategy implemented to help reach congestion goals in the SPC region. SPC documents the reasoning behind the strategy and its relationship to the agency's congestion targets. Before and after analysis is completed using results from monitoring traffic delay, and detailed information is included as to how calculations were reached and compared. This ensures that the same monitoring process can be reproduced indefinitely, allowing ongoing understanding of how investment in HOV lanes has enabled SPC to progress toward its congestion reduction target and its mobility goals.[37]

Program Delivery Monitoring at Missouri DOT

In the last decade, faced with increasing costs and decreasing revenue streams, the Missouri Department of Transportation (MoDOT) revisited its pavement management program. Based on financial constraints, the agency decided to focus its efforts on improving major highways, rather than spreading resources out over minor roads as well, as had been done according to a previous formula. MoDOT established a target that would benefit the most users per dollar spent and relaxed its target for overall pavement condition that included minor roads. As a result of this adjustment, fewer resources were allocated to the preservation of minor roads, and the percentage of minor roads in good condition decreased from 71% to 60% from 2005 to 2009.[38] At the same time, however, MoDOT was able to respond to customers' desires for smoother roads by significantly improving the condition of major routes, from 47% in 2004 to 87% in 2009. Currently over 89% of major highways are in good condition, but MoDOT again must recognize that this condition level will be difficult to maintain without additional resources.[39] MoDOT used its Tracker performance measurement tool to document this adjustment to its performance targets and measures and to monitor and report the results, which are released quarterly.

[35] Southwestern Pennsylvania Commission, "Congestion Management Process: Performance Measures," http://www.spcregion.org/trans_cong_pm.shtml
[36] Southwestern Pennsylvania Commission, "Congestion Management Process: Strategy Implementation and Monitoring Effectiveness," http://www.spcregion.org/trans_cong_mon.shtml
[37] http://www.spcregion.org/pdf/cmpdoc/Operational%20Improvements/ParkwayNorth_HOVAnalysis_April2008.pdf
[38] Missouri Department of Transportation. (October 2014). *Tracker: Measures of Departmental Performance,* "Keep Roads and Bridges in Good Condition", p. 2a.
[39] Missouri Department of Transportation. (October 2014). *Tracker: Measures of Departmental Performance,* "Keep Roads and Bridges in Good Condition", p. 2a.

STEP 5.2.5	Program/Project Level: Document the process
	Documenting the decision to focus more resources on major routes rather than on the system overall was key to MoDOT's ability to measure progress moving forward and also to ensure stakeholders understood the adjustment. MoDOT measures its progress not only with typical performance measures but also through regular customer satisfaction surveys and focus groups to determine whether improvement projects are making the anticipated progress toward a satisfactory user experience—therefore communicating this strategy back to users using monitoring data was critical.[40] This documentation shows how the programs and projects implemented as MoDOT's pavement strategies are intended to impact progress toward performance targets.
Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework) Component 02: Target Setting Component 03: Performance-Based Planning Component 04: Performance-Based Programming Component 06: Reporting and Communication Component C: Data Management Component D: Data Usability and Analysis

[40] National Cooperative Highway Research Program. (2010). Transportation Performance Management: Insight from Practitioners. NCHRP Report 660. Washington, DC. p. 35. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf

RESOURCES

Resource	Year	Link
TPM Toolbox	2016	www.tpmtools.org
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
Model Long Range Transportation Plans: A Guide for Incorporating Performance-Based Planning	2014	http://www.fhwa.dot.gov/planning/performance_based_planning/mlrtp_guidebook/fhwahep14046.pdf
Integrating Business Processes to Improve Travel Time Reliability	2011	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L01-RR-1.pdf
NCHRP Report 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf
NCHRP Report 660: Transportation Performance Management: Insight from Practitioners	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf

ACTION PLAN

1. Of the TPM sub-components discussed in this chapter, which one would you like to work on?

❑ 5.1 System Level Monitoring and Adjustment ❑ 5.2 Program/Project Level Monitoring and Adjustment

2. What aspect of the TPM process listed above do you want to change?

3. What "steps" discussed in this chapter do you think could help you address the challenge noted above?

System Level

- ❑ Determine monitoring framework
- ❑ Regularly assess monitoring results
- ❑ Use monitoring information to make adjustments
- ❑ Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions
- ❑ Document the process

Program/Project Level

- ❑ Determine monitoring framework
- ❑ Regularly assess monitoring results
- ❑ Use monitoring information to make adjustments
- ❑ Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions
- ❑ Document the process

4. To implement the "step" identified above, what actions are necessary, who will lead the effort and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success?

6. Who is someone (internal and/or external) I will collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

TABLE INDEX

U.S. Department of Transportation
Federal Highway Administration

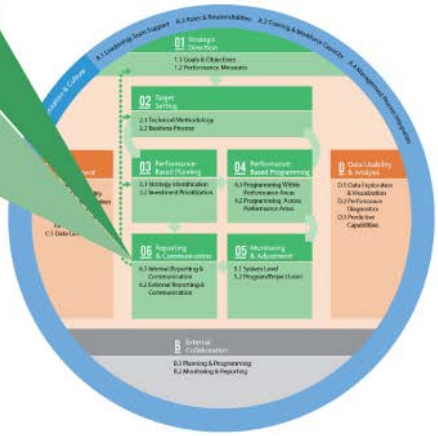
COMPONENT 6

REPORTING & COMMUNICATION

This chapter provides assistance to transportation agencies with the "Reporting and Communication" component of Transportation Performance Management (TPM). It discusses where reporting occurs within the TPM Framework, describes how it interrelates with the other nine components, presents definitions for associated terminology, provides links to regulatory resources, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for reporting and communication may differ from what is included in this chapter.

06 Reporting & Communication

6.1 Internal Reporting & Communication
6.2 External Reporting & Communication



Reporting and Communication is comprised of the products, techniques, and processes used to communicate performance information to different audiences for maximum impact. Reporting is an important element for increasing accountability and transparency to external stakeholders and for explaining internally how transportation performance management is driving a data-driven approach to decision making.

INTRODUCTION

Reporting and Communication is a key component of transportation performance management. Whether the agency is advancing toward attaining its strategic goals, falling behind or somewhere in between – TPM demands a rigorous reporting and communications practice to promote transparency and accountability. In addition, the sharing of performance information fuels the feedback loop to the strategic direction (Component 01), the setting of targets (Component 02), the identification and evaluation of strategies (Component 03), and the programming decisions (Component 04). Information included in reporting is an output of monitoring and adjustment processes (Component 05).

The Reporting and Communication process benefits an agency by:

- Promoting an open atmosphere through the sharing of performance results
- Enabling reevaluation of measures, targets, and strategies
- Facilitating a refocusing on goals/objectives
- Providing the opportunity to build internal and external support
- Sharing of results/attainment and non-attainment of targets

Reporting and Communication products should be:

- **Tailored to the audience:** To be effective, reporting products must be specifically designed for a particular audience.
- **Linked to funding:** In an era of budget constraints and significant need, agencies must use reports and communication strategies to convey how funding levels impact results.
- **Telling a story:** Simply reporting numbers and data is not effective; reporting should provide necessary context to ensure the agency controls the message and the user understands it.

SUBCOMPONENTS AND IMPLEMENTATION STEPS

Well-crafted communications products, whether a website filled with data or a printed banner highlighting a recent performance success, are vital tools for informing and involving both internal and external audiences in TPM. Such products are also an opportunity to articulate the connection between agency strategies and outcomes achieved. Linking decisions to results builds support among internal staff and external partners, as well as demonstrates the impact of increased or decreased funding.[1]

> "Measuring performance is of no value unless results are reported to the appropriate audiences in a way that makes the information readily understandable."
>
> Source: NCHRP Report 446: A Guidebook for Performance-Based Transportation Planning

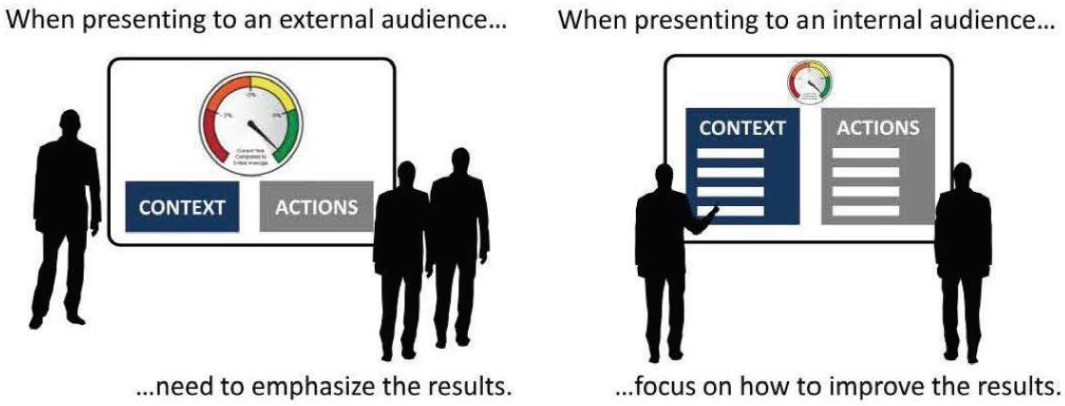
Communications products should build context and continuity so that the audience easily understands key takeaways regardless of prior familiarity. To this end, it is helpful to repeat or review prior performance before reporting new information.[2] In addition, it is important to explain how reporting fits within the overall transportation performance management process.

[1] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[2] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.

Information must be shared in ways that are appropriate to the intended audience, which means that internal and external reporting and communication practices will differ,[3] as demonstrated by Figure 6-1.

Figure 6-1: Tailoring Reporting by Audience

Source: US Department of Transportation[4]



AASHTO performed a research project focusing on strategies used to make a case for transportation projects, resulting in "The New Language of Mobility."[5] This research found that the public reacts more favorably to transportation efforts requiring increased revenue when certain words are used (green light language) to illustrate benefit, while other words should be avoided (red light language). Figure 6-2 below highlights examples of such language:

Figure 6-2: AASHTO Effective Communication Language

Source: AASHTO[6]

Green Light Language	Red Light Language
Accountability, responsibility	Maintenance, fixing
Choice	Public spending, spending money
Comprehensive strategy	Washington
Economy	
Efficient traffic	
Long-term plan	
State and local controlled	
Sustainable mobility	

[3] National Cooperative Highway Research Program. (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press. FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.

[4] US Department of Transportation, Federal Highway Administration, Office of Infrastructure. (2013). *FHWA Performance Reporting, Part Two of Two, Final Report* (Publication No. FHWA-HIF-13-044). Washington, DC.

[5] AASHTO. (2011). The New Language of Mobility. http://downloads.transportation.org/ANewWayToTalkAboutTransportation/NewLanguageofMobility.pdf

[6] American Association of State Highway and Transportation Officials. 2016. Washington, DC.

Because of the dual nature of reporting and communicating, this chapter has two subcomponents:

- **Internal Reporting and Communication:** products, techniques, and processes used to communicate performance information to internal audiences.
- **External Reporting and Communication:** products, techniques, and processes used to communicate performance information to customers, partner agencies, elected officials, and other stakeholders.

Internal communications target a wide variety of audiences, including the Board of Directors, department managers, and maintenance staff. While these reports will present information differently and with varying levels of detail, they will likely be used for at least some of the items in Table 6-1.[7]

Table 6-1: Uses of Internal and External Reporting and Communication

Source: Federal Highway Administration

Internal	External
Clarify how individual employees contribute to the performance results	Clarify outcomes achieved
Integrate TPM process into agency functions	Coordinate with the work of regional partners
Communicate the value of TPM to the agency and recognize achievements	Track attainment and non-attainment of goals
Connect current results to future actions	Communicate the interconnections between multiple goals
Track achievement of targets	Make the case for additional funding
Establish feedback loop to adjust performance measures, targets, and strategies	Build rapport with external groups, including receiving feedback on desired improvements

External communication is an opportunity to explain the TPM process to external stakeholders and how performance information is used in agency decision making. Reporting and communication embody the tenets of TPM: accountability and transparency. Goals, measures, and targets established in TPM Component 01 and 02 should be prominent in external reporting. Agencies should describe the performance-based decisions made and expected results in terms that external stakeholders will readily understand and avoid using jargon and technical language.[8] Based on audience and research feedback, FHWA's Performance Reporting Final Report[9] identifies five of the most significant problems when communicating results, and aligns them with solutions, as depicted below.

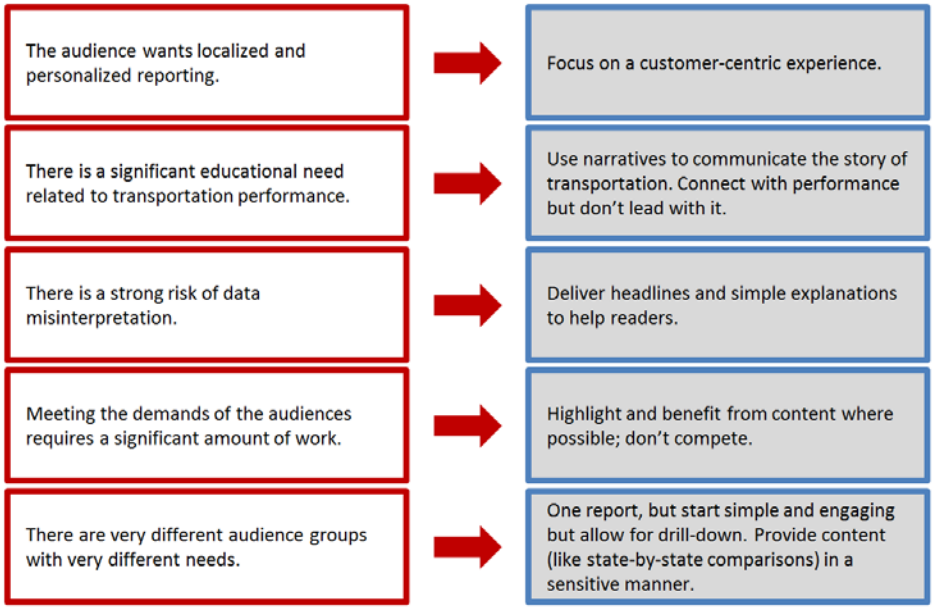
[7] National Cooperative Highway Research Program. (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press.

[8] National Cooperative Highway Research Program. (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press. FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.

[9] US Department of Transportation, Federal Highway Administration, Office of Infrastructure. (2013). *FHWA Performance Reporting, Part One of Two, Final Report* (Publication No. FHWA-HIF-13-044). Washington, DC. http://www.fhwa.dot.gov/tpm/resources/docs/hif13043.pdf

Figure 6-3: Performance Reporting Framework

Source: US Department of Transportation[10]



As stewards of the public's investment in transportation, the agency is accountable for using funds prudently. As illustrated in Figure 6-3, effective reporting shows customers that the agency is meeting this expectation, but also presents an opportunity to manage expectations by explaining challenges, discussing targets and clarifying accomplishments. Context should be provided when targets are exceeded or missed and when results differ from peer agencies or national trends.[11]

Figure 6-4 highlights research that found "telling a story" is imperative when trying to persuade an audience. Developing a narrative not only educates, but can serve to engage an audience and illustrate how transportation impacts one's life. FHWA's Performance Reporting Final Report highlights three central narratives and how these might align to tell a story, as shown below.

Figure 6-4: Developing Effective Narratives

Source: US Department of Transportation[12]

Central Narratives	Stories to Support the Narratives
Our Economic Well-Being	• The Cost of Congestion • Getting Your Stuff • Business Depends on it
Our Transportation Investment	• Keeping Us Moving • Taking Responsibility for Our Assets • Looking to Tomorrow
Our Mobile Lifestyle	• Expanding Your World • Keeping You Safe • Enhancing Community

[10] US Department of Transportation, Federal Highway Administration, Office of Infrastructure. (2013). *FHWA Performance Reporting, Part One of Two, Final Report* (Publication No. FHWA-HIF-13-044). Washington, DC. http://www.fhwa.dot.gov/tpm/resources/docs/hif13043.pdf

[11] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.

[12] US Department of Transportation, Federal Highway Administration, Office of Infrastructure. (2013). *FHWA Performance Reporting, Part One of Two, Final Report* (Publication No. FHWA-HIF-13-044). Washington, DC. http://www.fhwa.dot.gov/tpm/resources/docs/hif13043.pdf

Table 6-2 provides examples of how communications to different audiences will have different purposes in addition to differing levels of detail and focus. As a result, even though the same basic material is used and in many cases the same staff develops both external and internal reporting, the types of products can differ in terms of their approach and content.[13]

Table 6-2: Audience and Potential Purpose of Communication

Source: Federal Highway Administration

Audience	Potential Purpose
Internal Staff	Motivate productivity and efficiency
External Partners	Leverage greater investment and collaboration
Leadership (i.e., Governor)	Drive policy relating to a given goal
Regulatory	Meet legislative requirements

Table 6-3 presents the implementation steps for Reporting and Communication that will be discussed in depth in this chapter.

Table 6-3: Reporting and Communication Implementation Steps

Source: Federal Highway Administration

Internal	External
1. Clarify purpose of the report	1. Clarify purpose of the report
2. Define roles and responsibilities	2. Define roles and responsibilities
3. Develop reporting parameters	3. Coordinate with external partners
4. Refine, automate, and document	4. Develop reporting parameters
	5. Refine, automate, and document

CLARIFYING TERMINOLOGY

Table 6-4 presents definitions for reporting terms used in this guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table 6-4: Reporting and Communication: Defining Common TPM Terminology

Source: Federal Highway Administration[14]

Common Terms	Definition	Example
Goal	A broad statement of a desired end condition or outcome; a unique piece of the agency's vision	A safe transportation system.

[13] National Cooperative Highway Research Program. (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press.

[14] Vision and mission examples from: Minnesota Department of Transportation. http://www.dot.state.mn.us/vision/

Common Terms	Definition	Example
Mission	Statement that reflects the core functional purpose of an agency.	Plan, build, operate and maintain a safe, accessible, efficient and reliable multimodal transportation system that connects people to destinations and markets throughout the state, regionally and around the world.[15]
Objective	A specific, measurable statement that supports achievement of a goal.	Reduce the number of motor vehicle fatalities.
Outcome	Results or impacts of a particular activity that are of most interest to system users. Focus of subcomponent 5.1 System Level Monitoring and Adjustment.	Transit travel time reliability, fatality rate, percent of assets within useful life.
Output	Quantity of activity delivered through a project or program. Focus of subcomponent 5.2 Program/Project Level Monitoring and Adjustment.	Miles of pavement repaved, miles of new guardrail put into place, the number of bridges rehabilitated, the number of new buses purchased.
Performance Measure	Performances measures are based on a metric that is used to track progress toward goals, objectives, and achievement of established targets. They should be manageable, sustainable, and based on collaboration with partners. Measures provide an effective basis for evaluating strategies for performance improvement.	Transit passenger trips per revenue hour.
Target	Level of performance that is desired to be achieved within a specific time frame	Two % reduction in fatality rate in the next calendar year.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.
Vision Statement	An overarching statement of desired outcomes that is concisely written, but broad in scope; a vision statement is intended to be compelling and inspiring.	Minnesota's multimodal transportation system maximizes the health of people, the environment, and our economy.

[15] Vision and mission examples from: Minnesota Department of Transportation. http://www.dot.state.mn.us/vision/

RELATIONSHIP TO TPM COMPONENTS

The ten TPM components are interconnected and often interdependent. Table 6-5 summarizes how each of the nine other components relate to the reporting and communication component.

Table 6-5: Reporting and Communication Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to Reporting and Communication
01. Strategic Direction	The establishment of an agency's focus through well-defined goals/objectives and a set of aligned performance measures.	The Strategic Direction provides the context surrounding performance reporting.
02. Target Setting	The use of baseline data, information on possible strategies, resource constraints and forecasting tools to collaboratively establish targets.	Reports use targets as references; performance results inform the achievability of targets.
03. Performance-Based Planning	Use of a strategic direction to drive development and documentation of agency strategies and priorities in the long-range transportation plan and other plans.	Reporting of performance levels informs adjustment of agency strategies and the prioritization of strategies to drive target attainment.
04. Performance-Based Programming	Allocation of resources to projects to achieve strategic goals, objectives and performance targets. Clear linkages established between investments made and their expected performance outputs and outcomes.	Reporting compares expected to actual outputs and outcomes, enabling adjustment of programming to refocus on goals, objectives and performance targets.
05. Monitoring and Adjustment	Processes to monitor and assess actions taken and outcomes achieved. Establishes a feedback loop to adjust programming, planning, and benchmarking/target setting decisions. Provides key insight into the efficacy of investments.	Monitoring provides the information to be reported, and communication of monitoring results drives adjustment of agency processes.
A. TPM Organization and Culture	Institutionalization of a TPM culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support TPM.	Reporting addresses each group within the agency, building knowledge of and focus on transportation performance management by all staff while connecting multiple TPM processes.
B. External Collaboration and Coordination	Established processes to collaborate and coordinate with agency partners and stakeholders on planning/ visioning, target setting, programming, data sharing, and reporting.	External reporting establishes trust and encourages transparency and dialogue with external partners and other stakeholders.
C. Data Management	Established processes to ensure data quality and accessibility, and to maximize efficiency of data acquisition and integration for TPM.	Developed data management processes streamline the reporting process by making information readily accessible and useful.

Component	Summary Definition	Relationship to Reporting and Communication
D. Data Usability and Analysis	Existence of useful and valuable data sets and analysis capabilities, provided in usable, convenient forms to support TPM.	Mature data usability and analysis capabilities enable tracking of agency outputs and outcomes to be reported.

REGULATORY RESOURCES

This Guidebook is intended to assist agencies with implementing transportation performance management in a general sense and not to provide guidance on compliance and fulfillment of Federal regulations. However, it is important to consider legislative requirements and regulations when using the Guidebook. In many cases, use of this Guidebook will bring an agency in alignment with Federal requirements; however, the following sources should be considered the authority on such requirements:

Federal Highway Administration

- Transportation Performance Management: http://www.fhwa.dot.gov/tpm/links_fhwa.cfm
- Fact Sheets on Fixing America's Surface Transportation (FAST) Act: https://www.fhwa.dot.gov/fastact/factsheets/
- Fact Sheets on Moving Ahead for Progress in the 21st Century (MAP-21): https://www.fhwa.dot.gov/map21/factsheets/
- Resources on MAP-21 Rulemaking: https://www.fhwa.dot.gov/tpm/rule.cfm

Federal Transit Administration

- Fact Sheets on FAST Act: https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-fast-act
- Resources on MAP-21: https://www.transit.dot.gov/regulations-and-guidance/legislation/map-21/map-21-program-fact-sheets

IMPLEMENTATION STEPS

6.1 INTERNAL REPORTING AND COMMUNICATION

The following steps will enable effective internal reporting of transportation performance management information:

1. Clarify purpose of the report
2. Define roles and responsibilities
3. Develop reporting parameters
4. Refine, automate, and document

> "Reporting performance data [promotes an] understanding of the impacts of investment decisions…on the state of the transportation system, [providing] the key inputs that should be used to establish priorities during subsequent strategic planning phases and to measure progress on previous strategic goals."
>
> Source: NCHRP Report 660: Transportation Performance Management: Insight from Practitioners

STEP 6.1.1	Clarify purpose of the report

Description

This step highlights the need for clarity in report intent. Before starting to create a report, it is important to initiate a discussion among a range of potential users of the report to determine how the report will be used internally. The report may be intended to influence change within the agency, or it may connect implemented changes to operational results. The group of users will determine its purpose, setting the stage for creating a valuable and useful report.

To target the appropriate level of staff, reports will be written with varying degrees of detail. For executives, data may be more high-level with the option to drill down; operational staff will be more interested in details, especially if the purpose of the report is to effect change in operational strategies. If performance has fallen short of targets, the report should demonstrate this in a sensitive way. This should be carefully considered to ensure a positive and proactive response from report users.

Different staff has varying levels of understanding as well; it will be important to provide context as necessary for full comprehension by the intended audience. Context can be established by recalling state or federal law or noting examples in other states where measures were used to achieve desired outcomes.

Table 6-6: Identifying Stakeholders and Understanding Roles

Source: Federal Highway Administration

Audience	Potential Purpose
Secretary/General Manager	Prepare for meetings with elected officials
Executive managers	Hold department heads accountable for performance results
Department heads	Identify areas in need of attention
Operational staff	Link daily work activities to performance results

The agency should determine whether the specified audience is high enough in the organization to influence change vs. operationally connected to implement those changes. Without custom tailoring for the audience, the report will contain excess measures and

STEP 6.1.1	Clarify purpose of the report

documentation which will distract from the main message. Users may tune out or become frustrated.

Items to keep in mind:

- Connect TPM to existing business processes
- Define the TPM process and why it is beneficial
- Specify how the report will be used
- Tailor to the audience
- Consider user reaction to falling short of targets
- Report on most critical items for internal management needs

Examples

Targeted Performance Reporting[16]

The diagram below clearly shows how various reporting products can be used by which staff and how those reports vary in level of detail and focus. Dashboards can provide high-level information to the public and elected officials in an easy to understand format, while annual performance reports can include more detail while still maintaining an overall perspective. Reports to the Secretary or Director will often be to prepare that individual for meetings with department heads or elected officials and should be tailored to this purpose. Department business plans can be used to maintain focus on actions that will produce positive performance outcomes by guiding discussions during department or office meetings. Specific tracking of performance within particular areas is more relevant to frontline works and office heads and should be reflected in reports at this level.

Figure 6-5: Hierarchy of Reporting Methods and Tools

Source: Washington Metropolitan Area Transportation Authority[17]

Linkages to Other TPM Components	Component A: Organization and Culture	(See TPM Framework)

[16] FHWA. (2012). Performance-Based Planning and Programming. (FHWA Publication FHWA-HEP-12-042). Washington, DC.
[17] Washington Metropolitan Area Transit Authority. (May 15, 2014). Moving Towards Performance-Based Management. Washington, DC.

STEP 6.1.2	Define roles and responsibilities
Description	This step entails specifying staff to deliver the report. Once the purpose of a particular report is identified, staff within the agency must be assigned to gather information, write, and design the report. Because every part of the organization contributes to performance results, every part of the agency will also need to report either separately or contribute to an overall agency report. Ideally department staff will undertake this important aspect of transportation performance management, but some agencies engage a transportation performance management office to assist. When departments take responsibility for reporting their own results, staff has ownership over the process, which in turn encourages involvement throughout each of the components in the TPM framework. Staff responsibility for particular performance areas should be clear. Because TPM is a process with each component interrelated, reported information will eventually be used to adjust agency strategies, goals, and targets. Without clearly-defined staff member responsibilities, adjustment and improvement is less likely to occur. **An agency should:** • Ensure management and executive support and reinforcement • Assign staff to seek feedback on past reporting efforts, and to improve subsequent reports for use in decision-making • Identify who within the departments or performance office will actually do the writing, feedback solicitation, etc. • Link to existing processes that require reporting as much as possible to reduce duplicative work
Examples	**The Gray Notebook Award: Rewarding Employees** The Washington State DOT has a performance trophy called the Gray Notebook Award, which is given out to an employee who goes above and beyond in contributing to reporting efforts. The award is given out quarterly, coinciding with the agency's release of its quarterly performance report, The Gray Notebook. Award winner keeps the trophy for the quarter and their name is engraved on the plaque. The award is one way WSDOT is able to continually produce such an impressive reporting piece.  WSDOT **Figure 6-6: Staff Award at WSDOT** Source: WSDOT[18]

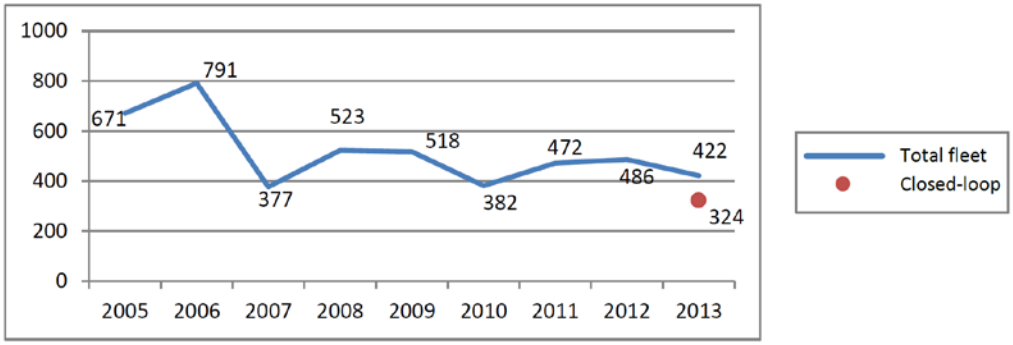
[18] Washington State Department of Transportation. (2015). Olympia, WA.

STEP 6.1.2	Define roles and responsibilities
	TriMet: Portland, OR The agency posted a map at garages showing the location of bus collisions along routes in an attempt to highlight areas of low performance to bus operators. Unfortunately, because of limited staff time and resources, the map data was not updated regularly enough to be useful to operators. TriMet had a great idea for reporting performance internally, but the challenges faced in maintaining this internal reporting demonstrates how important it is to have staff capacity for reporting roles, and to clearly define responsibilities for staff to complete reporting tasks on an ongoing basis.
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework)

STEP 6.1.3	Develop reporting parameters
Description	This step addresses the need to define how the report will look visually, and what data is included. The **reporting format** chosen will be impacted by the purpose of the report determined in step 6.1.1. To produce a useful report, the reporting parameters should reflect the needs of the intended audience and enable the reported information to be easily digestible. Decisions can range from simple (web v. hard copy) to more difficult (infographic v. graph v. interactive data display). Take into account how much detail and added context is necessary in the report and how this may impact the format. Above all, the most important information should be presented prominently and in a comprehensible manner. **Other items to consider when developing reporting parameters include:** • **Frequency:** If a report will be produced frequently, the format should be simple to reduce effort required. It is also important to consider whether agency investments might produce results in the short or long term. By reporting quarterly results for a measure that will not be affected by investments for a number of years, it will appear that agency strategies are not effective. Because reporting will affect these strategies, reporting must be done thoughtfully to avoid unnecessary or potentially counterproductive adjustments. In addition, high-level reporting should coincide with decision cycles and be infrequent.[19] • **Data sources:** Determine where performance data will be derived from and when they will be available for use. Avoid committing to monthly reports if data will only be available quarterly. Data must also be accurate. • **Alignment to TPM framework:** Reporting should be undertaken with the knowledge that it will influence other TPM components (e.g., goals, measures, targets, plans). • **Inclusion of actionable information:** Without this, reporting serves little purpose

> "Too much data becomes not enough information – focus on the most important data and present it in a way that can be understood."
>
> - Eric Hesse, TriMet

[19] National Cooperative Highway Research Program. (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press.

STEP 6.1.3	Develop reporting parameters
	within the transportation performance management framework; agency approaches must be adjusted based on reported information to ensure that desired outcomes (goals) are being achieved. Often, internal reporting focuses on output measures because they more directly relate to agency activities.[20] • **Mandates:** Does reporting meet federal or state legislative or regulatory requirements? Does it help explain the impact of current and future investment levels? • **Internal evaluations:** Will information be used for individual or department evaluations? Is there a reward or recognition structure associated with any measures? Should an employee be able to link their job to these measures?
Examples	**Reporting to Adjust** The Rhode Island DOT Maintenance Division, responsible for winter roadway maintenance, adopted performance measures to assess salt, brine, and sand usage. To reduce winter maintenance costs, the DOT installed closed-loop controllers on a portion of the maintenance vehicle fleet. These controllers provide more uniform salt and sand application compared to standard systems, and also allow computerized data tracking of application. By installing these devices on only a portion of the fleet, the DOT could compare usage and costs between standard and closed-loop vehicles. The new technology achieved a 20-30 reduction in material usage, as shown in the graph below. Reporting using easy to read graphs enables staff to quickly understand important information that will allow the DOT to more efficiently use resources. **Figure 6-7: Average Pounds of Salt Per Lane Mile** Source: Moving a DOT to Excellence with Performance Measures[21] 
Linkages to Other TPM Components	Component 01: Strategic Direction Component 02: Target Setting Component 03: Performance-Based Planning Component C: Data Management Component D: Data Usability and Analysis (See TPM Framework)

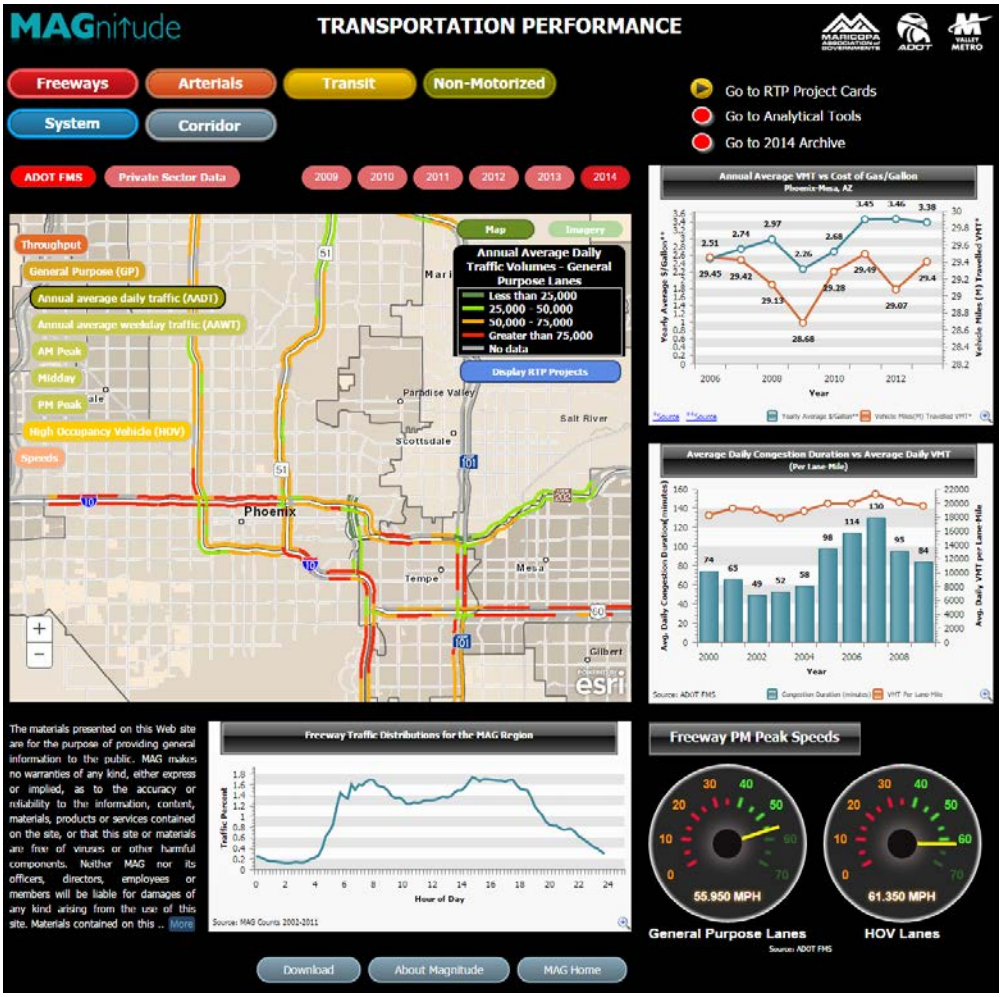
[20] National Cooperative Highway Research Program. (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press.
[21] Moving a DOT to Excellence with Performance Measures. Presentation by Christos Xenophontos, June 2, 2015. http://onlinepubs.trb.org/onlinepubs/conferences/2015/performancemeasurement/Xenophontos-4PS.pdf

STEP 6.1.4	Refine, automate, and document
Description	Reports should be continuously refined based on user feedback. Each subsequent report should be improved to ensure the agency is telling its story in the most effective manner. Encourage report users to identify where improvements can be made, and ensure that a range of users are solicited for their feedback to avoid tailoring too finely for only a small subset of the intended audience. A staff member assigned to obtain feedback under step 6.1.2 should fulfill this responsibility for both internal and external reports. With feedback in hand, staff should return to step 6.1.3 to refine things such as frequency and format. Each round of reporting should build on the previous one to improve usability and value for addressing performance challenges. Reporting is not a rote exercise; the feedback and refinement process is a critical one because of the impact reporting will have on agency strategies and subsequent results. "We're constantly reevaluating our reports, thinking tactically, strategically, about relevance." - Daniela Bremmer, WSDOT As much as possible, gather data automatically. This will reduce time required for staff to assemble and produce the report. For example, existing communication templates can be auto-populated with new data for the quarter, year, or other performance period being used. However, be cautious with automation. If data quality issues exist, even partially automated reports are likely to communicate inaccurate information. Ensure the process of data gathering, calculation, writing, publication and solicitation of feedback is documented. Include data sources, individuals who fulfilled particular roles, intended audience, user feedback, etc. Most reports will be produced on a regular basis and documentation will streamline the process in the future and protect against loss of institutional knowledge if a key member of the team changes positions.
Examples	**Maricopa Association of Governments (MAG)** The Performance Management Program at MAG was initiated as a result of 2004 state legislation that mandated a performance-based Regional Transportation Plan (RTP) subject to a performance audit starting in 2010 and every five years thereafter. Passage of Proposition 400 in Maricopa County authorized a half-cent sales tax for 20 years to fund transportation projects. As part of the shift towards transportation performance management and to report on the projects funded by the sales tax, MAG created two robust reporting tools: MAGnitude—a web-based transportation performance dashboard, and a web based RTP Project Card portal.

STEP 6.1.4	Refine, automate, and document

Figure 6-8: MAG Web-Based Transportation Performance User Interface

Source: MAGnitude Transportation Performance[22]



Refining: Since launching the interactive website, MAGnitude has reached many audiences and received constructive feedback from users; as a result of many requests for data from past years, the site now includes archived data from 2009 through 2014. While the process for obtaining feedback is not formalized, such feedback information is still being used to refine reporting and communication tools for future use.

Automating: Staff understand the limits of automation in reporting; it is cost prohibitive to automate data processing to the point where it is accurate enough for simultaneous use by internal technical staff, member agency staff and the consulting community. MAG has developed automated data analytics, processing and quality control steps and routines with a built-in final visual check before publication on MAGnitude.

Documenting: MAG has created a technical manual that describes processing steps to make raw data usable for incorporation into the MAGnitude reporting site. This is a great example of

[22] Maricopa Association of Governments. MAGnitude - Transportation Performance. June 2, 2016. http://performance.azmag.gov/About.aspx

STEP 6.1.4	Refine, automate, and document
	documentation ensuring that institutional memory and noteworthy practices are not lost as a result of staff turnover.
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework) Component C: Data Management

6.2 EXTERNAL REPORTING AND COMMUNICATION

The following steps will assist an agency in implementing an effective external reporting process to communicate transportation performance management information:

1. Clarify purpose of the report
2. Define roles and responsibilities
3. Coordinate with external partners
4. Develop reporting parameters
5. Refine, automate, and document

> "An overarching goal of performance management is to increase transparency and accountability of decision-making. Translating the analysis conducted as part of performance management into usable reports for legislators, stakeholders, and the public is an important component to overall success."
>
> Source: NCHRP Report 660: Transportation Performance Management: Insight from Practitioners

STEP 6.2.1	Clarify purpose of the report
Description	This step highlights the importance of clarity of report intent. Because external audiences will be less familiar with transportation performance management terminology and processes, it is important to clearly explain this information and why it is beneficial. To resonate with external audiences, the agency should connect activities to outcomes that are visible and relatable. Reporting to the public should focus mainly on outcome measures that resonate with the public.[23] Providing context concerning legislative and regulatory requirements can be useful, but only if written in a way that focuses on aspects that the audience cares about. External audiences will not be concerned with minutiae of laws or internal agency prioritization processes, but do expect that agency resources were used effectively to address problems like congestion that are experienced by external individuals on a regular basis. Most importantly, external reporting should effectively communicate agency goals, how and why resources were allocated in a particular way, and what results were achieved from those allocation decisions. This is critical; the public expects the agency to be an effective steward of the public money entrusted to it. The public also may not understand tradeoffs across performance areas. Agency staff should clearly communicate the budget constraints that exist and how focusing on particular areas of performance necessitates a reduced focus in other areas. This will help build support among the public for other processes, including performance-based planning (Component 03) and performance-based programming (Component 04). Communicating to elected officials can be the most critical task for an agency, especially when making the case for additional funding. **Some approaches that may be effective include:** • Demonstrate what the agency gets in terms of performance results with different levels of funding[24]

[23] National Cooperative Highway Research Program. (2000). *A Guidebook for Performance-Based Transportation Planning* (NCHRP Report 446). Washington, DC: National Academy Press.
[24] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.

STEP 6.2.1	Clarify purpose of the report
	• Give historical information like the effect of inflation on a fixed amount of funding[25] • Show savings by completing maintenance now instead of putting it off until a major expensive repair or replacement is necessary[26] • Provide counterfactual info to demonstrate agency impact despite worsening conditions – congestion is increasing, but investments slowed the increase[27]

Examples

Oregon DOT: Communicating to a Lay Audience[28]

The overview page below demonstrates how the Oregon Department of Transportation seeks to communicate important information in a way that a general audience can understand. A graph shows the data so the user can get a quick sense of the trend, while the surrounding text explains agency strategy, how the target has changed over time, and benchmarks performance with peer agencies. It also includes information about what other factors might influence results to provide greater context to the agency's activities to reduce derailment incidents. Not shown are data source, reporting frequency, and a contact person for further information. All of this information will be important to document in step 6.2.5.

Figure 6-9: Oregon DOT Derailment Reporting

Source: Oregon Department of Transportation[29]

Derailment incidents: Number of train derailments caused by human error, track, or equipment

Our strategy

We want to have the safest infrastructure possible. **Safe infrastructure** mitigates structural safety risks on Oregon's transportation system. Working with the Federal Railroad Administration, we use a combination of inspections, enforcement actions and industry education to improve railroad safety and reduce the incidence of derailments and the potential for release of hazardous materials.

About the target

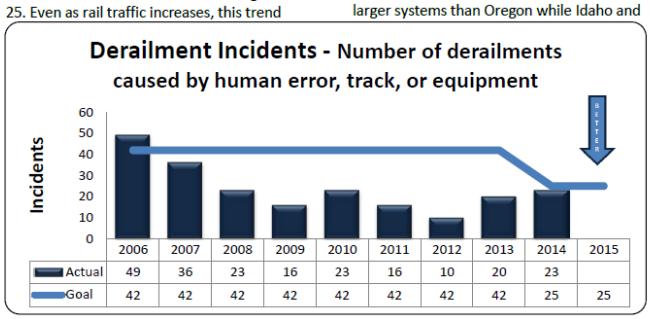
The number of derailments has steadily decreased to a level below the target. For 2014 and 2015 we've lowered the target to 25. Even as rail traffic increases, this trend indicates significant improvement.

How we are doing and how we compare

In 2014, there were 23 derailment incidents, an increase from the 20 derailments in 2013. From 2006 to 2014, derailments have decreased 53 percent from 49 to 23. According to FRA's 2013 – 2014 data for Oregon and its neighboring states, derailments increased in Oregon, decreased in Idaho and California and remained the same Washington and Nevada. The rail systems differ among the states in terms of track miles and the number of carloads, e.g.... California and Washington have much larger systems than Oregon while Idaho and Nevada have much smaller systems. A comparison of derailments per track mile (miles of track in each state) for 12 months ending December 31, 2014, shows Oregon with .0096 incidents per track mile, Washington with .0063, Nevada with .0059, Idaho with .0056 and California with .0096.

Factors affecting results and what needs to be done

From 2013 to 2014, Oregon showed a 15 percent increase in derailments. This can be attributed to an increase in rail traffic, an increase in derailments caused by human error and an increase in track caused yard derailments. During the same time,



Fact

From 2006 to 2014, derailments have decreased 53 percent from 49 to 23.

[25] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[26] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[27] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[28] http://www.oregon.gov/ODOT/CS/PERFORMANCE/OnePagers/Derailment%20Incidents%20One%20pager.pdf
[29] Oregon Department of Transportation. (2016). Derailment Incidents. Salem, OR. http://www.oregon.gov/ODOT/CS/PERFORMANCE/OnePagers/Derailment%20Incidents%20One%20pager.pdf

STEP 6.2.1	Clarify purpose of the report

***we*Move Massachusetts: Communicating the Impact of Funding on Performance**[30]

As part of the first multimodal LRTP, MassDOT used an analytical tool to understand asset level performance over time. The document compared projected performance results under two funding scenarios—historical, and current funding levels that reflected an increase in state funding. This tool helped to justify funding decisions by allowing decision makers and the public to understand that, in a constrained funding environment, tradeoffs exist when funding certain areas over others. By funding certain projects, impacts on asset performance can be improved. For many of the assets, the tool demonstrated that performance would deteriorate from current conditions even with funding higher than historical levels due to the nature of asset age and deterioration curves. With further refinement and a potential web interface, this tool is intended to be effective both internally—in making funding decisions—and externally in communicating such decisions to officials and the public at large.

Figure 6-10: MassDOT Funding Scenarios and Performance Outcomes through 2023

Source: *weMove Massachusetts*: Planning for Performance[31]

	2012		Historical Funding		Current Funding	
	Division Funding (Annual $ in Millions)	Today's Performance	Scenario Funding (Annual $ in Millions)	2023 Performance	Scenario Funding Annual $ (millions)	2023 Performance
Highway Division						
Pavement (% state of good repair)[a]	$137	88%	$267	71%	$544	79%
Bridges (average health index)[b]	$620	89%	$353	72%	$447	76%
Mobility (delay hours/1000 VMT)[c]	$147	4.8	$65	6.3	$386	5.4
Safety (intersections or segments improved)	$49	TBD[e]	$26	528	$65	1,304
Bicycle Facilities (% of Bay State Greenway completed)	$25	31%	$26	87%	$26	86%
Highway Subtotal	***$977***		***$738***		***$1,468***	
Rail and Transit Division						
MBTA Bridges (% state of good repair)	$41	65%	$34	47%	$34	47%
MBTA Subway Elevators/Escalators (% state of good repair)	$13	60%	$11	56%	$11	56%
MBTA Accessibility	$22	72%	$18	79%	$18	79%
MBTA Rolling Stock (% state of good repair)	$209	58%	$173	46%	$341	61%
MBTA Track (daily hours of delay)	$18	16.0	$15	23.7	$40	21.0
MBTA Signal (signal failures)	$22	1,900	$18	2,485	$43	2,025
MBTA Add Rapid Transit/Rail Access (households walking distance to station)[d]	$0	0	$0	0	$319	88,867

Figure 6-11: MassDOT Funding Scenarios and Performance Outcomes through 2040

Source: *weMove Massachusetts*: Planning for Performance [32]

	2012		Historical Funding		Current Funding	
	Division Funding (Annual $ in Millions)	Today's Performance	Scenario Funding (Annual $ in Millions)	2040 Performance	Scenario Funding Annual $ (millions)	2040 Performance
Highway Division						
Pavement (% state of good repair)[a]	$137	88%	$267	30%	$544	60%
Bridges (average health index)[b]	$620	89%	$353	61%	$447	69%
Mobility (delay hours/1000 VMT)[c]	$147	4.8	$65	8.9	$386	6.9
Safety (intersections or segments improved)	$49	TBD[e]	$26	1,426	$65	3,524
Bicycle Facilities (% of Bay State Greenway completed)	$25	31%	$26	100%	$26	100%
Highway Subtotal	***$977***		***$738***		***$1,468***	
Rail and Transit Division						
MBTA Bridges (% state of good repair)	$41	65%	$34	19%	$34	19%
MBTA Subway Elevators/Escalators (% state of good repair)	$13	60%	$11	49%	$11	49%
MBTA Accessibility	$22	72%	$18	89%	$18	89%
MBTA Rolling Stock (% state of good repair)	$209	58%	$173	42%	$341	70%
MBTA Track (daily hours of delay)	$18	16.0	$15	57.7	$40	35.2
MBTA Signal (signal failures)	$22	1,900	$18	3,880	$43	2,207
MBTA Add Rapid Transit/Rail Access (households walking distance to station)[d]	$0	0	$0	0	$319	88,867

A detailed section provides information about the measures used, customer impacts, and the performance value for the years 2023 and 2040, which correspond to separate investment

[30] Massachusetts Department of Transportation. (2014). we*Move Massachusetts: Planning for Performance*. Boston, MA. http://www.massdot.state.ma.us/Portals/22/Docs/WMM_Planning_for_Performance.pdf

[31] Massachusetts Department of Transportation. (2014). weMove Massachusetts: Planning for Performance. Boston, MA. http://www.massdot.state.ma.us/Portals/22/Docs/WMM_Planning_for_Performance.pdf

[32] Massachusetts Department of Transportation. (2014). weMove Massachusetts: Planning for Performance. Boston, MA. http://www.massdot.state.ma.us/Portals/22/Docs/WMM_Planning_for_Performance.pdf

STEP 6.2.1	Clarify purpose of the report

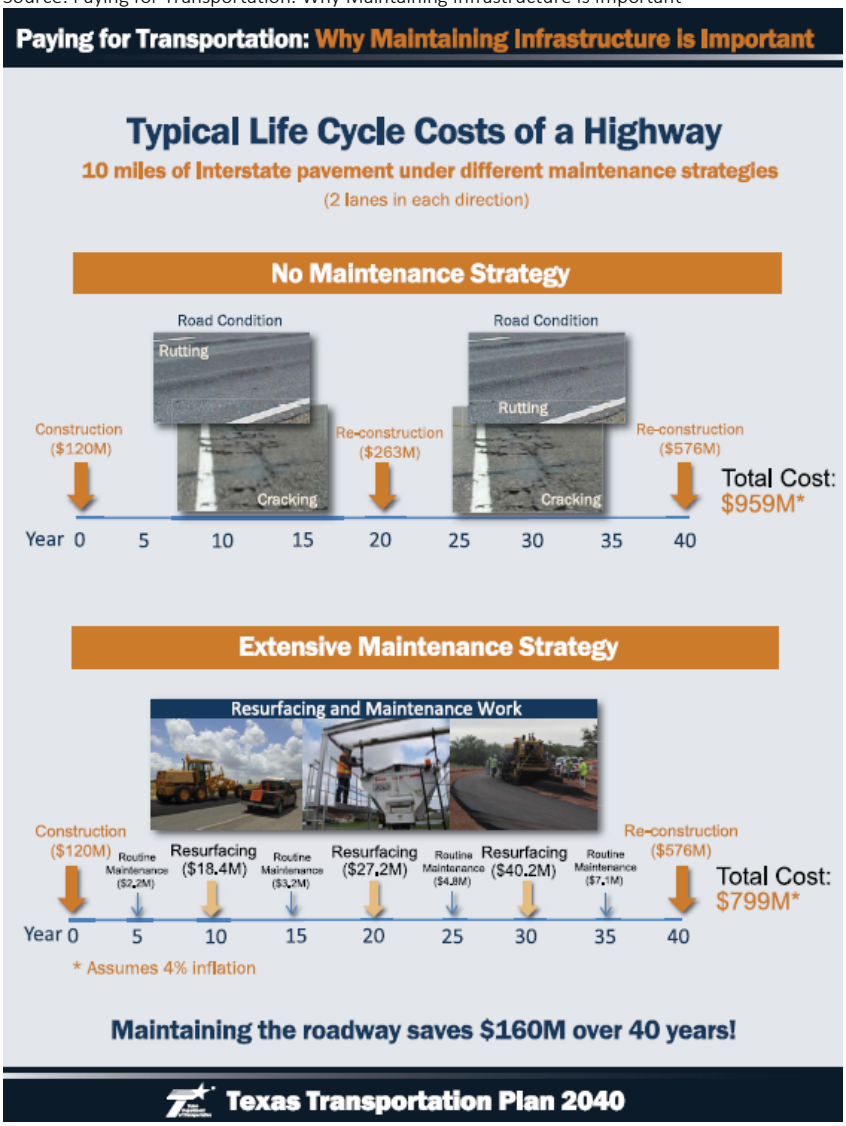
plan target data and the *we*Move planning horizon, respectively. Following this are tables (shown) summarizing and comparing performance levels currently and in the future under varying funding scenarios.

TxDOT: Communicating Maintenance Cost Savings[33]

The Texas Department of Transportation's LRTP, Texas Transportation Plan 2040, includes a one-page graphical representation of the life-cycle cost savings stemming from a regular maintenance program for Interstate pavement. The comparison clearly demonstrates the importance of proactive maintenance to those not closely involved in such activities.

Figure 6-12: TxDOT LRTP Comparative Maintenance Cost Analysis

Source: Paying for Transportation: Why Maintaining Infrastructure Is Important [34]



[33] http://ftp.dot.state.tx.us/pub/txdot-info/tpp/2040/life-cycle-costs-of-a-highway.pdf

[34] Texas Department of Transportation. (2015). Paying for Transportation: Why Maintaining Infrastructure Is Important. Austin, TX. ftp://ftp.dot.state.tx.us/pub/txdot-info/tpp/2040/life-cycle-costs-of-a-highway.pdf

STEP 6.2.1	Clarify purpose of the report
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework)

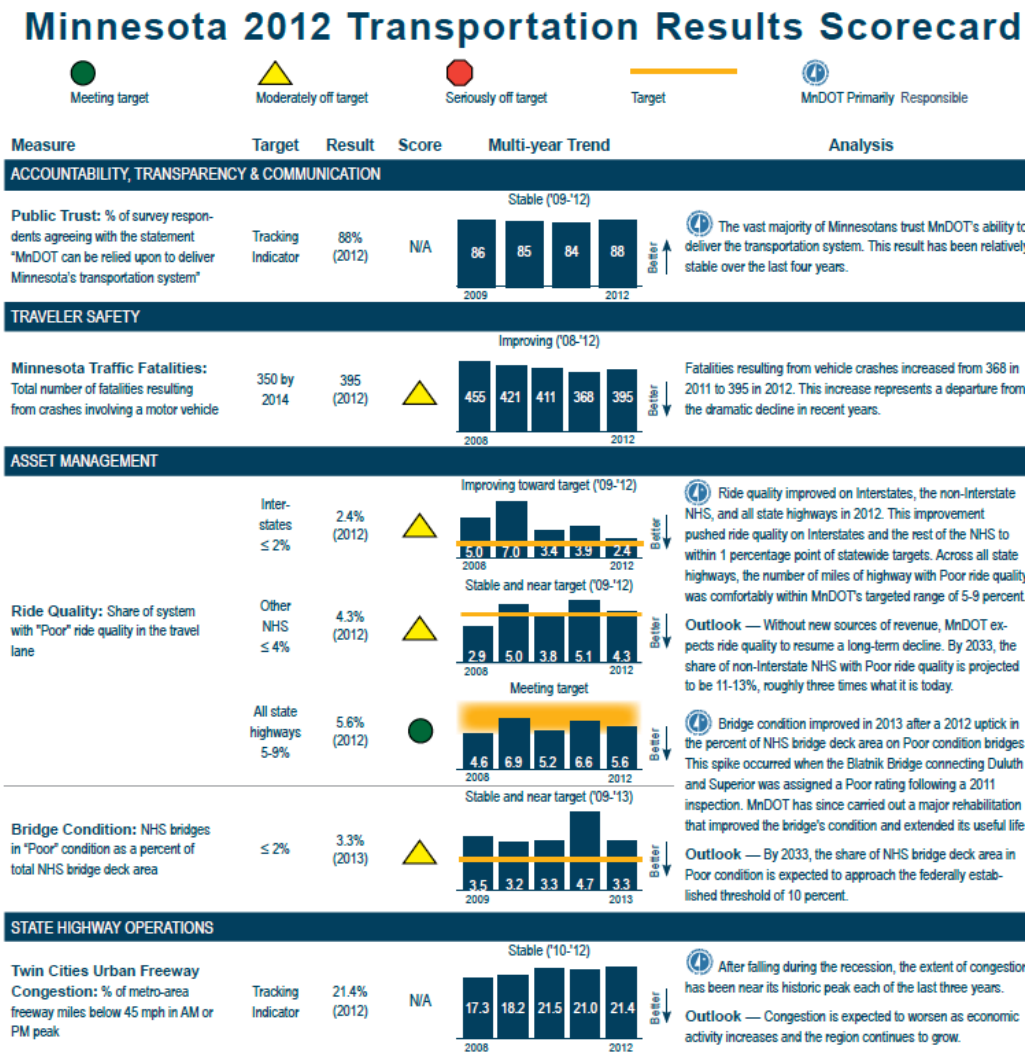
STEP 6.2.2	Define roles and responsibilities
Description	Internal staff will need to be assigned to complete external reporting work. In many cases, the same staff will do both internal and external reporting because of the significant overlap. However, it is important to pay attention to the variations. One important variation in this step pertains to use of reporting in stakeholder groups. Management and executive staff should be consistent in how they are speaking about performance among external groups, using the same data and context (or performance story). Some agencies establish a communications plan that lays out presentation methods, formats, and approaches to ensure messaging is consistent, unified, and cohesive across communications products. This is particularly important when reporting to decision makers, the public and other stakeholders. Internally, managers should discuss this to reduce confusion over inconsistent communication to external audiences. **Internal discussions should address:** • The effect of missing or exceeding targets and how this will be received by stakeholders, especially by those in control of funds • How to build trust, including by reporting both good and bad performance results • Ways to make reporting interactive • Which staff member will track feedback over time
Examples	**MnDOT: Reporting the Bad, Too**[35] The Annual Performance Report tracks achievement relative to six objectives laid out in the Minnesota GO Statewide Multimodal Transportation Plan 2013-2032. It includes a scorecard with 17 measures the agency uses to track performance, calculate investment levels, and guide decision making. In the introduction of the report, "Highlights," also mentions an increase in traffic fatalities and serious injuries, as well as little progress towards reducing historically high congestion in the Twin Cities area. Additionally, the list of 2012 "Challenges" is almost twice as long as the list of "Performance Gains." MnDOT staff has chosen to be open and forthcoming with agency results, both positive and negative. This type of report illustrates the breadth of roles required to compile the data. In the scorecard below, it is clear that distinct areas across the organization contribute to the report, including asset management, operations, and safety.

[35] Minnesota Department of Transportation. (2012). *Annual Transportation Performance Report*. St. Paul, MN. http://www.dot.state.mn.us/measures/pdf/2012ReportBooklowrez4-15.pdf

STEP 6.2.2	Define roles and responsibilities

Figure 6-13: Maintaining Accountability through Transparent Reporting at MnDOT

Source: Annual Transportation Performance Report[36]



WisDOT: Interactive Reporting[37]

The Wisconsin Department of Transportation reports performance information quarterly using an interactive web tool coupled with a static Performance Scorecard. Users can quickly see information displayed graphically for different measures and by clicking About Measure, can link to the particular Scorecard section that provides details including target, importance, data frequency, agency Division, how the measure is calculated, influencing factors, and progress made towards attainment.

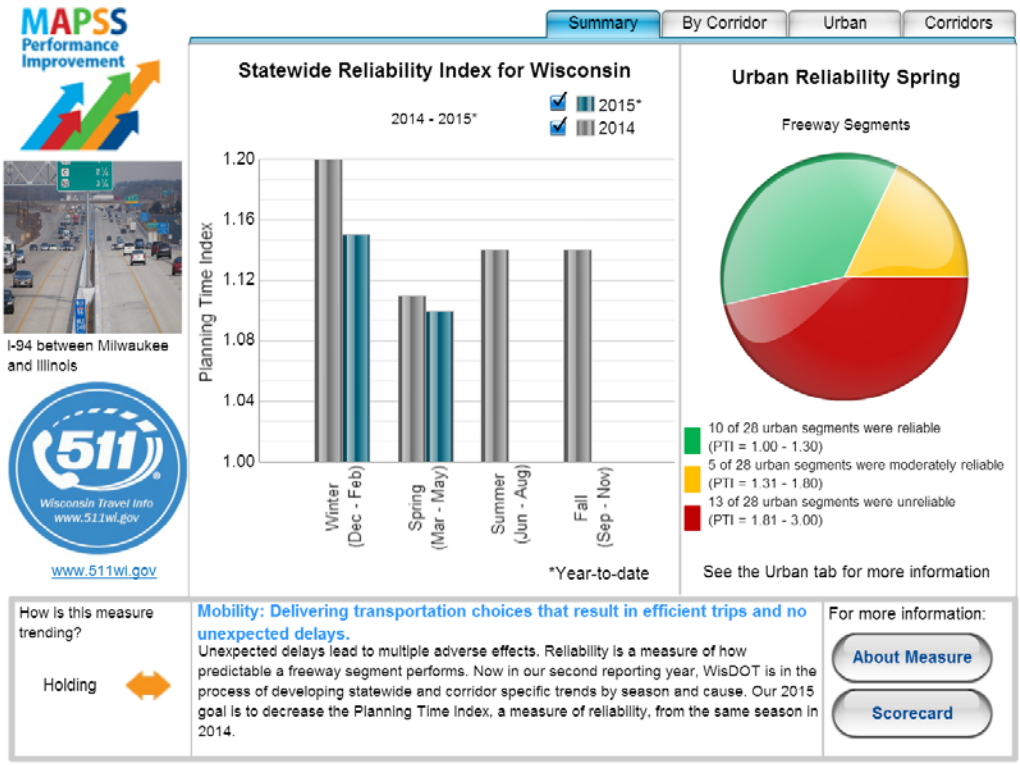
[36] Minnesota Department of Transportation. (2012). Annual Transportation Performance Report. St. Paul, MN. http://www.dot.state.mn.us/measures/pdf/2012ReportBooklowrez4-15.pdf

[37] Wisconsin Department of Transportation. (2015). *MAPSS Performance Improvement: Reliability (planning time index)*. Madison, WI. http://wisconsindot.gov/Pages/about-wisdot/performance/mapss/measures/mobility/reliability.aspx

STEP 6.2.2	Define roles and responsibilities

Figure 6-14: WisDOT Interactive Reporting for Public Use

Source: *MAPSS Performance Improvement: Reliability (planning time index)*[38]



Linkages to Other TPM Components	Component A: Organization and Culture	(See TPM Framework)

STEP 6.2.3	Coordinate with external partners

Description

This step refers to the need for coordination with external stakeholders. Coordination speaks to the need to organize various elements within a complex environment. To appropriately tailor reporting to an external audience, the agency should coordinate with such partners. MPOs, rural transportation planning organizations, and others closely related to agency activities and outcomes will be impacted by the agency's performance. Exceeding, attaining, or missing a target will have an effect on these groups, and this should be discussed in formation of the report. The agency should also consider how external organizations impact agency performance–do these groups help or hinder target attainment?

Alignment across stakeholders can assist agencies in target attainment, and the following general steps can promote effective coordination:

[38] Wisconsin Department of Transportation. (2015). *MAPSS Performance Improvement: Reliability (planning time index)*. Madison, WI. http://wisconsindot.gov/Pages/about-wisdot/performance/mapss/measures/mobility/reliability.aspx

STEP 6.2.3	Coordinate with external partners
	• Embrace a vision • Set common goals • Know the team • Define roles and responsibilities • Plan • Communicate Advocacy groups may react negatively if not consulted before final release of a report, especially if performance has not been trending in the expected or desired direction. Consultation benefits the agency by potentially reducing negative attention stemming from poor performance. However, negative attention should not be avoided by providing incomplete information, or by hiding negative results; doing so will only damage the agency's relationship with external groups. Because external audiences are less likely to understand intricate performance information (as discussed in step 6.2.1), it is particularly important to tell an effective performance story. Presenting data to support claims is important, but should be supplemented by narrative information that will resonate with external partners. Engagement, discussion, and communication with external stakeholders provide insight and knowledge that will position staff to best provide reporting that will be useful and actionable. Another consideration is reporting schedule. While this will be addressed mainly in the next step 6.2.4, it is important to coordinate with reporting by partners. It might make sense to report together by bundling publications, or at least release reports at similar times.
Examples	**Engage with the Media** The Washington State Department of Transportation (WSDOT) tried a new approach to engaging with media when releasing its 2015 Corridor Capacity Report. This report is the agency's congestion report and includes statewide analysis of multimodal capacity and system performance. Instead of releasing the report to the media and the public at large, the agency decided to provide an embargoed copy to selected media in advance. This approach was well received, and enabled WSDOT to better control the story to ensure the public got the right information in an effective way. It also provided an opportunity to identify which questions the agency couldn't currently answer, and should consider finding answers for in the next reporting round. Such a relationship with the media brings significant benefits to an agency, both in public relations and in refining future reporting. A resulting Seattle Times article provides context surrounding the additional congestion seen since the recession, including information about lower gas prices, a recovering economy, and how the results may have influenced state legislators to support a 12-cent gas tax increase.[39]

[39] Lindblom, M. October 26, 2015. State: More drivers, more gridlock, more delays. *The Seattle Times*. http://www.seattletimes.com/seattle-news/transportation/state-report-more-drivers-more-gridlock-more-delays/

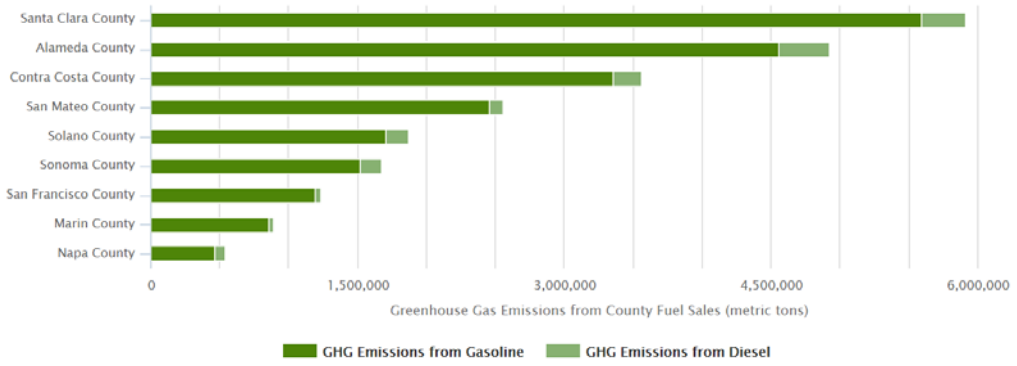
STEP 6.2.3	Coordinate with external partners

Vital Signs Report: Coordinated Reporting Across Partners[40]

The Metropolitan Transportation Commission, the MPO for the San Francisco Bay Area, collaborated with the Association of Bay Area Governments to write PlanBayArea, a comprehensive housing, transportation, and land use strategy document that includes the 2040 RTP. Beyond being a logical combination of integrated issues, the work was prompted by SB 375, the California Sustainable Communities and Climate Protection Act of 2008. This required that every metropolitan area draft a Sustainable Communities Strategy to reduce greenhouse gas emissions from vehicles in part by promoting compact, mixed-use development near transit. PlanBayArea is the Bay Area's Strategy.

PlanBayArea contains a number of regional performance measures which are presented to the public via the Vital Signs portal, a user-friendly and interactive website. The format of the website gives the public a clear understanding of what the performance measures are, what they mean, and how they link to community concerns. It integrates measures from MTC, the Association of Bay Area Governments, the Bay Area Air Quality Management District, and the San Francisco Conservation and Development Commission, enabling external audiences a one-stop shop for these organizations' reporting.

Figure 6-15: S.F. Bay Area MPO 2012 Greenhouse Gas Emissions from Fuel Sales by County
Source: Vital Signs[41]



Linkages to Other TPM Components	Component B: External Collaboration and Coordination	(See TPM Framework)

STEP 6.2.4	Develop reporting parameters

Description

Many of the same considerations discussed in step 6.1.3 for internal reporting apply for external reporting as well:

- Reporting format
- Level of detail and context

[40] Metropolitan Transportation Commission. *Vital Signs.* http://www.vitalsigns.mtc.ca.gov/
[41] Metropolitan Transportation Commission. Vital Signs - Greenhouse Gas Emissions. June 2, 2016. http://www.vitalsigns.mtc.ca.gov/greenhouse-gas-emissions

STEP 6.2.4	Develop reporting parameters
	• Frequency • Data sources • Alignment to TPM framework • Mandates External reporting does not need to include information regarding the use of the report for internal evaluations. Additionally, external reporting should not include actionable information unless being used to coordinate operations with partners. Typically actionable information would only be useful to internal staff. At a transit agency for example, information on late departures from the bus depot for each driver allows management to work with particular drivers to address late departures and improve overall on-time performance. However, this information has little value to riders; they are more likely to understand and to care about overall on-time performance because it better reflects their riding experience. Many agencies use dashboards to present data to an external audience in a way that is easy to understand. However, there is a risk of oversimplifying information by using this format, which leaves important agency reporting open to misinterpretation.[42] To prevent this problem, agencies can tell a performance story (step 6.2.3) in conjunction with a dashboard. Highlight anomalies or contextual information that may explain why a target was not attained: a particularly harsh winter, legalization of marijuana significantly increasing congestion stemming from out-of-state visitors, etc. This will help external groups understand the greater context involved. When selecting a format to use, review other reports the agency has made to external groups. If there is a format that is already familiar to these audiences, it may make sense to continue using the same format for ease of use and consistency. Some agencies push to have complete reports ready for the beginning of the legislative session as a way to make the case for additional funding. This approach can be effective if performance has been improving due to past funding increases, or if performance has declined and the agency can connect lack of funding to poor performance results. **Consider how performance data will be presented:** • Actual v. Competitor Actual • Actual v. Target • Actual v. Plan • Actual v. Prior Month • Actual v. Prior Quarter • Actual v. Prior Year (particularly for long-term targets) • Actual v. Same Month Last Year • Actual v. Same Quarter Last Year
Examples	**WSDOT: The Gray Notebook[43]** The Washington State Department of Transportation produces a quarterly performance report called The Gray Notebook that serves as an excellent example of external reporting.

[42] FHWA. (2013). *Performance-Based Planning and Programming Guidebook* (FHWA Publication FHWA-HEP-13-041). Washington, DC.
[43] http://www.wsdot.wa.gov/Accountability/GrayNotebook/

STEP 6.2.4	Develop reporting parameters

Figure 6-16: WSDOT Gray Notebook

Source: The Gray Notebook Volume 58[44]

Format: Infographics and maps

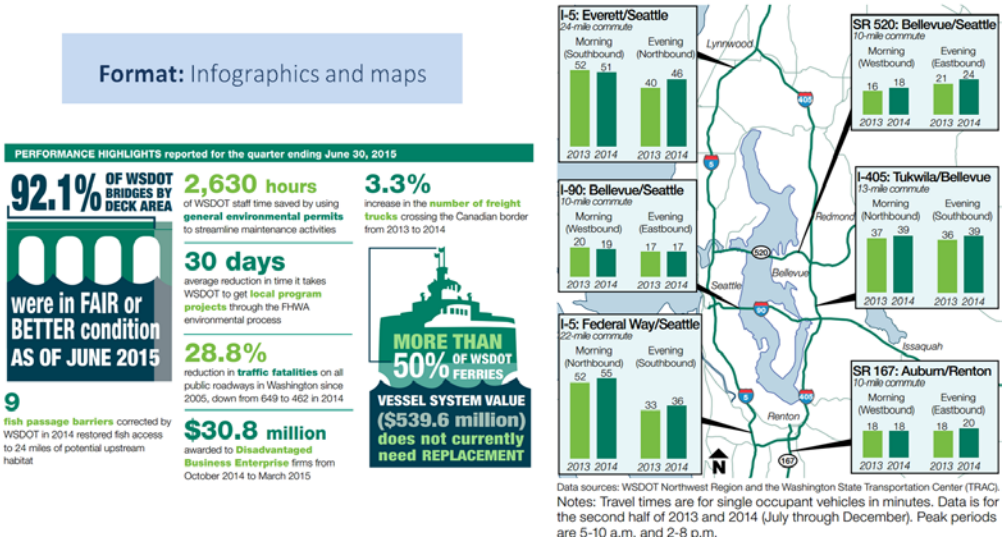
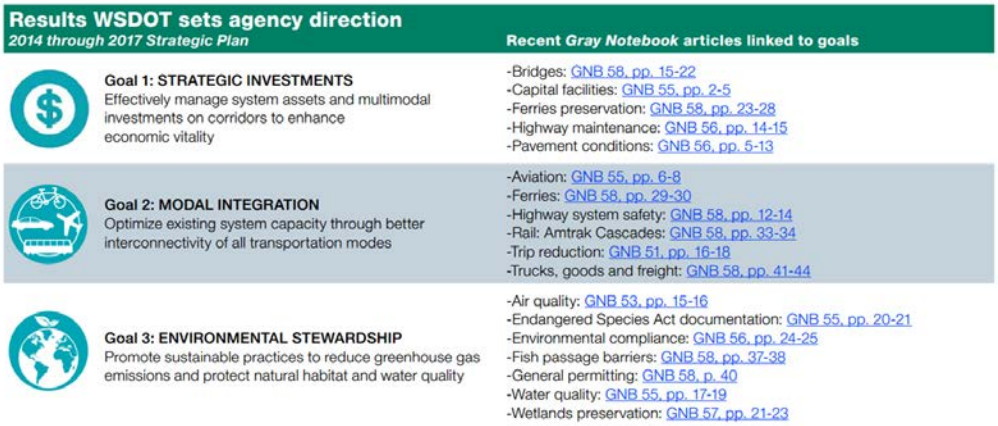


Figure 6-17: WSDOT Gray Notebook

Source: The Gray Notebook Volume 58[45]

Level of detail and context: Performance reporting is clearly connected to agency goals, which are described in greater detail for users. Results WSDOT, the agency's strategic plan, "sets agency direction."



[44] Washington State Department of Transportation. (2015). The Gray Notebook: WSDOT's Quarterly Performance Report on Transportation Systems, Programs, and Department Management (June 30, 2015). Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/Jun15.pdf

[45] Washington State Department of Transportation. (2015). The Gray Notebook: WSDOT's Quarterly Performance Report on Transportation Systems, Programs, and Department Management (June 30, 2015). Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/Jun15.pdf

STEP 6.2.4	Develop reporting parameters

Figure 6-18: WSDOT Gray Notebook

Source: The Gray Notebook Volume 58[46]

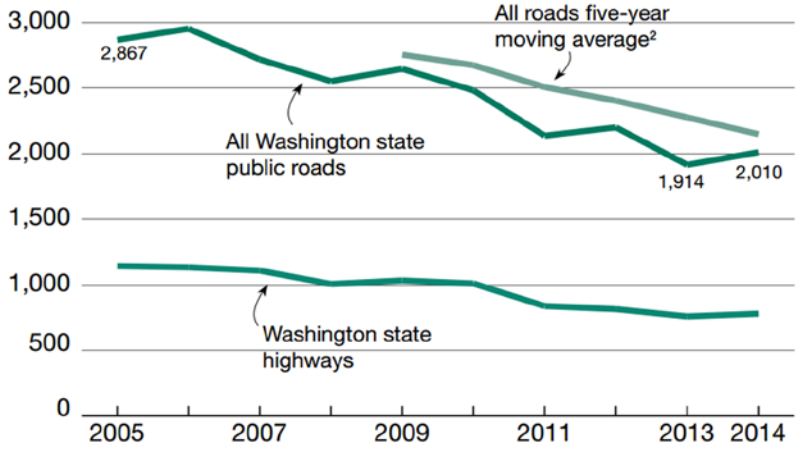
Frequency: Frequency of reporting is identified for each performance measure listed in the first column.

Mobility (Congestion Relief)						
Highways: Annual (weekday) vehicle **hours of delay** statewide at **maximum throughput speeds**[2] (Annual measure: calendar years 2012 & 2013)	30.9 million	32.4 million	N/A	N/A		↓
Highways: Average **incident clearance times** for all Incident Response program responses (Calendar quarterly measure: Q1 2015 & Q2 2015)	12.2 minutes	12.3 minutes	N/A	N/A	(Five-quarter trend)	↓
Ferries: Percentage of trips departing on time[3] (Fiscal quarterly measure: year to year Q4 FY2014 & Q4 FY2015)	95.8%	94.2%	Above 95%	—		↑
Rail: Amtrak Cascades on time performance (Annual measure: calendar years 2013 & 2014)	77.3%	70.0%	Above 80%	—		↑

Figure 6-19: WSDOT Gray Notebook

Source: The Gray Notebook Volume 58[47]

Data Sources: are identified where data is displayed.



Data sources: Fatality Analysis Reporting System (FARS), WSDOT Transportation Data and Geographic Information Systems Office.

[46]Washington State Department of Transportation. (2015). The Gray Notebook: WSDOT's Quarterly Performance Report on Transportation Systems, Programs, and Department Management (June 30, 2015). Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/Jun15.pdf

[47] Washington State Department of Transportation. (2015). The Gray Notebook: WSDOT's Quarterly Performance Report on Transportation Systems, Programs, and Department Management (June 30, 2015). Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/Jun15.pdf

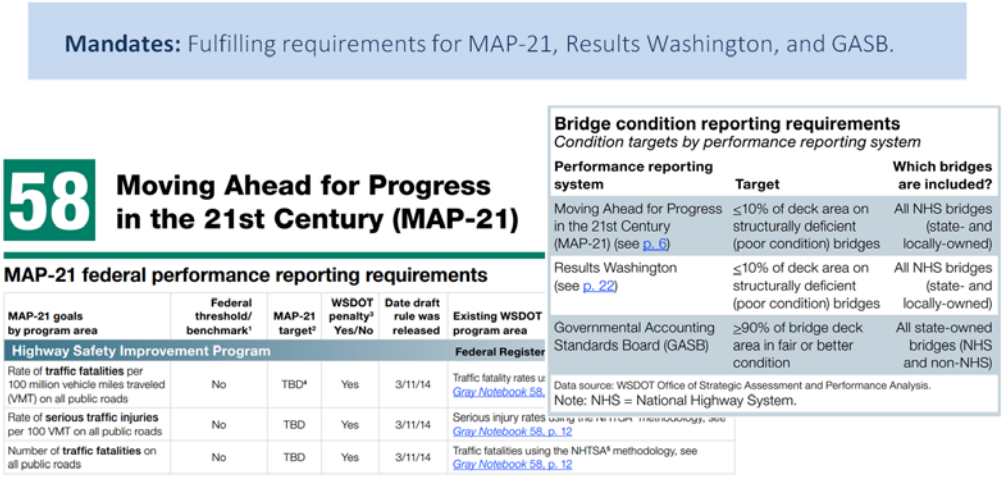
STEP 6.2.4	Develop reporting parameters

Figure 6-20: WSDOT Gray Notebook

Source: The Gray Notebook Volume 58[48]

Figure 6-21: WSDOT Gray Notebook

Source: The Gray Notebook Volume 58[49]



[48] Washington State Department of Transportation. (2015). The Gray Notebook: WSDOT's Quarterly Performance Report on Transportation Systems, Programs, and Department Management (June 30, 2015). Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/Jun15.pdf

[49] Washington State Department of Transportation. (2015). The Gray Notebook: WSDOT's Quarterly Performance Report on Transportation Systems, Programs, and Department Management (June 30, 2015). Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/Jun15.pdf

STEP 6.2.4	Develop reporting parameters

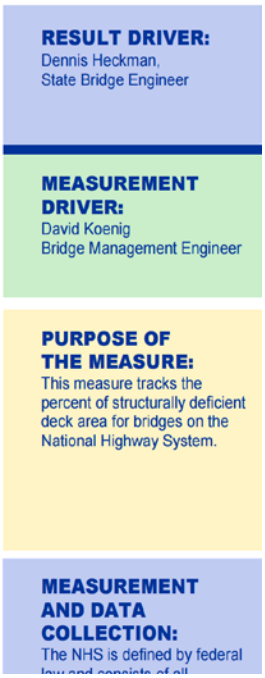
Michigan DOT: Communicating Context[50]

To provide greater context around agency performance, the Michigan DOT created a website called Transportation Reality Check, which identifies commonly-held myths concerning the transportation system and presents factual information to demonstrate the actual situation and why it exists. Each myth is debunked with a short video and a one-page fact sheet which provide information in an easily-digestible manner. Myth #6 pertains to state taxes on gasoline and what they fund, making it clear that poor road conditions experienced by users stem from too little funding.

Figure 6-22: Michigan DOT Transportation Reality Check Public Education Initiative
Source: Transportation Reality Check[51]

Linkages to Other TPM Components	Component B: External Collaboration and Coordination Component C: Data Management Component D: Data Usability and Analysis	(See TPM Framework)

[50] Michigan Department of Transportation. (2015). *Transportation Reality Check*. http://www.michigan.gov/mdot/0,4616,7-151-9620_67533---,00.html
[51] Michigan Department of Transportation. (2016). Transportation Reality Check: Myth #6. Lansing, MI. http://www.michigan.gov/documents/mdot/RealityCheckMyth6_473561_7.pdf

STEP 6.2.5	Refine, automate, and document
Description	Similar to step 6.1.4 for internal reporting, documentation will streamline the reporting process in the future, reducing demands on staff time. **Record things like:** • Frequency • Data source • Format • Who fulfilled roles and responsibilities outlined in step 6.2.2 • Which external audience the report intended to reach To refine external reporting efforts, feedback should be gathered from recipients across a broad range of external groups engaged by the agency. This includes the public at large, which may access performance information through the agency website. Record all feedback where staff can access it in the future. Methods, approaches, and staff assumptions should be reevaluated after each reporting round. For external reporting, it is particularly important to explain how and why certain measures and targets were chosen. Without a clear and logical explanation, the reporting document will fail to gain credibility among external audiences. Reports should tell a performance story rather than simply reporting data.
Examples	**Missouri DOT: Effective Documentation**  The Missouri Tracker report[52] clearly documents a wealth of information, including: • Frequency of reporting, by measure • Staff members responsible for measure (result driver, measurement driver) • Purpose of the measure • How data is collected All measures used within the agency are summarized at the beginning of the report, which also serves as a table of contents to guide users to detail pages produced for each measure. Detail pages include the side panel pictured here, as well as trend graphs, narrative description, and data source. **Figure 6-23: Missouri Tracker Documentation** Source: Tracker: Measures of Departmental Performance[53]

[52] Missouri Department of Transportation. (2016). Tracker: Measures of Departmental Performance. Jefferson City, MO. http://www.modot.org/about/documents/April2016Tracker.pdf
[53] Missouri Department of Transportation. (2016). Tracker: Measures of Departmental Performance. Jefferson City, MO. http://www.modot.org/about/documents/April2016Tracker.pdf

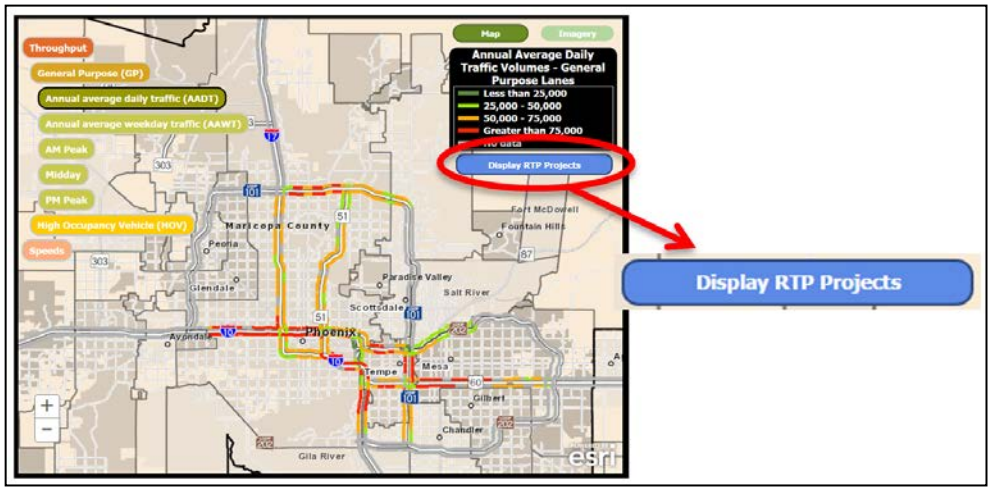
STEP 6.2.5	Refine, automate, and document

Maricopa Association of Governments

The MAGnitude reporting site discussed earlier has been refined not only based on internal feedback, but from external feedback as well. Member agencies and consultants routinely requested additional information about how projects from the Regional Transportation Plan relate to performance results. MAG staff fulfilled their request by incorporating project information into the interactive map on the site.[54]

Figure 6-24: Tracking Public Investment in Transportation Infrastructure at MAG

Source: MAG Performance Measurement[55]



Your CDOT Dollar: Explaining Measures[56]

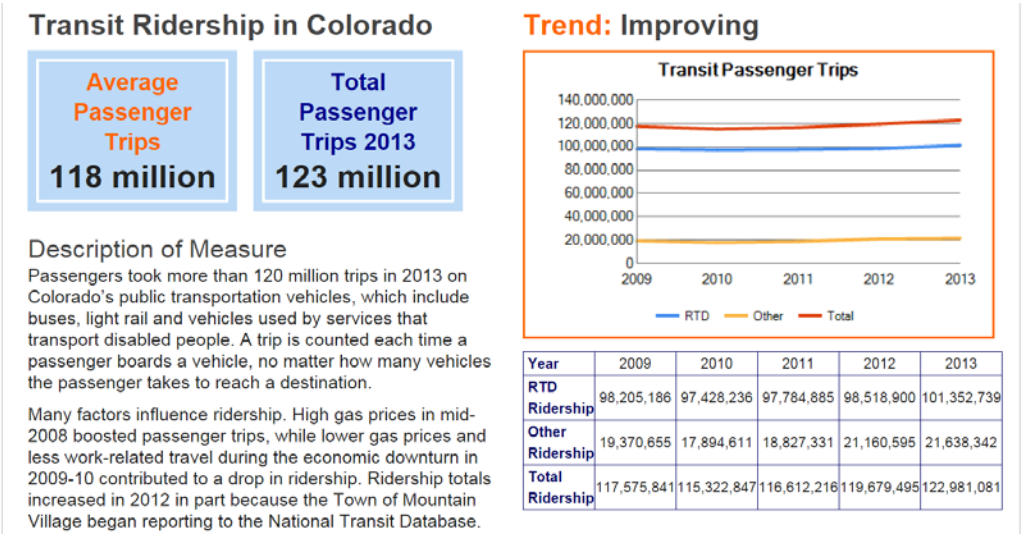
In addition to graphically displaying performance and grading results on a letter scale, the Colorado DOT provides information about how a measure is calculated. For transit ridership, the description informs the user that a trip is counted each time a passenger boards a vehicle. Because measures are often calculated differently across different agencies, this is critical information to have to fully understand the performance results being displayed.

[54] http://performance.azmag.gov/About.aspx
[55] Maricopa Association of Governments. MAGnitude- Performance Measurement. June 2, 2016. http://performance.azmag.gov/About.aspx
[56] Colorado Department of Transportation. *Your CDOT Dollar*. http://dtdapps.coloradodot.info/otis/YCD/Roads#highways-tab

STEP 6.2.5	Refine, automate, and document

Figure 6-25: Public Transportation Ridership Reporting at CDOT

Source: Your CDOT Dollar[57]



Year	2009	2010	2011	2012	2013
RTD Ridership	98,205,186	97,428,236	97,784,885	98,518,900	101,352,739
Other Ridership	19,370,655	17,894,611	18,827,331	21,160,595	21,638,342
Total Ridership	117,575,841	115,322,847	116,612,216	119,679,495	122,981,081

Linkages to Other TPM Components	Component A: Organization and Culture	(See TPM Framework)
	Component B: External Collaboration and Coordination	

[57] Colorado Department of Transportation. *Your CDOT Dollar*. June 2, 2016. http://dtdapps.coloradodot.info/otis/YCD/Mobility#transit-tab

RESOURCES

Resource	Year	Link
TPM Toolbox	2016	www.tpmtools.org
Communicating Performance	2015	http://communicatingperformance.com/
Performance-Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
FHWA Performance Reporting: Part one of two Final Report	2013	http://www.fhwa.dot.gov/tpm/resources/docs/hif13043.pdf
The New Language of Mobility	2011	http://downloads.transportation.org/ANewWayToTalkAboutTransportation/NewLanguageofMobility.pdf
A Guidebook for Performance-Based Transportation Planning (NCHRP Report 446)	2000	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf

ACTION PLAN

1. Of the TPM subcomponents discussed in this chapter, which one would you like to work on?

   ❑ 6.1 Internal Reporting and Communication ❑ 6.2 External Reporting and Communication

2. What aspect of the TPM process listed above do you want to change?

3. What "steps" discussed in this chapter do you think could help you address the challenge noted above?

Internal Reporting

- ❑ Clarify purpose of the report
- ❑ Define roles and responsibilities
- ❑ Develop reporting parameters
- ❑ Refine, automate, and document

External Reporting

- ❑ Clarify purpose of the report
- ❑ Define roles and responsibilities
- ❑ Coordinate with external partners
- ❑ Develop reporting parameters
- ❑ Refine, automate, and document

4. To implement the "step" identified above, what actions are necessary, who will lead the effort and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success?

6. Who is someone (internal and/or external) I will collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

TABLE INDEX

U.S. Department of Transportation
Federal Highway Administration

COMPONENT A

ORGANIZATION AND CULTURE

This chapter provides assistance to transportation agencies with the "Organization and Culture" component of Transportation Performance Management (TPM). It discusses where organization and culture occurs within the TPM Framework, describes how it interrelates with the other nine components, presents definitions for associated terminology, provides links to regulatory resources, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for organization and culture may differ from what is included in this chapter.

A Organization & Culture

A.1 Leadership Team Support
A.2 Roles & Responsibilities
A.3 Training & Workforce Capacity
A.4 Management Process Integration

Organization and Culture refers to the institutionalization of a transportation performance management culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support transportation performance management.

INTRODUCTION

For transportation performance management (TPM) to take hold within an agency, the organization and culture must be supportive. Changes to an established organizational structure and processes can be difficult for staff to accept. But when managed properly, the reward for an agency can be substantial. If the instituted changes are able to provide benefit to a broader group within the organization, the new way of conducting business will gain employee buy-in.

Transportation performance management can become a core agency activity when assimilated thoughtfully among staff, and adoption of TPM principles can contribute to improved results for the agency, system users, external partners, and funders. The discipline of adapting individuals within an organization to a different business culture and new business processes is often called change management.[1] Change management is practiced today in different ways by different transportation agencies, but the key principles remain the same and provide several benefits.

Benefits include:

- Staff work as a cohesive unit rather than within silos
- Leadership can better justify activities from a data-driven perspective
- Policymakers see the agency as responsible, transparent, and accountable
- Employees discover efficiencies that reduce overall workload and expense

Note how the Organization and Culture component is depicted in the TPM Framework; it encompasses each of the other nine components because it impacts each component. Building a TPM culture is critical to the sustainability of processes established in other components. Without a supportive culture that has embedded structures and processes for TPM, newly implemented activities may fall by the wayside after only one or two performance cycles. This chapter provides implementation steps that, using a change management approach, will help an agency adjust its own structure and culture to better support TPM.

This change in structure and culture often occurs amidst a shift in other organizational priorities. Managing by performance results is rarely as simple as quantifying organizational and individual performance within existing goals. Rather, it frequently entails an affirmation–if not a complete reassessment–of agency vision and mission. Whether driven by a change in agency administration or by new legislation that prescribes performance metrics, leadership must not only align staff performance expectations with its management philosophies, but it should also foster an environment where change is embraced.

> "We are focused on having an organization made up of people who are motivated and responsible for improving their work, while humble and helpful to those around them."
>
> - Jerry Benson, Utah Transit Authority

Component 01 of this guidebook details the importance of developing strategic goals for the organization that serve as the overall guiding force for agency decisions. All TPM activities tie back to agency goals, and staff should be focused on these goals as much as possible. Agencies often craft vision and mission statements before developing goals. A vision statement concisely and broadly describes desired outcomes and provides a basis for developing goals that more specifically spell out what the agency wants to achieve. Vision statements should serve as rallying

[1] Prosci. (2016). What is Change Management? https://www.prosci.com/change-management/what-is-change-management. Retrieved 13 June 2016.

points for staff. Mission statements reflect the core functional purpose of the agency. The Federal Highway Administration's vision and mission are listed below as examples:[2]

- **Vision:** Our agency and our transportation system are the best in the world.
- **Mission:** To improve mobility on our Nation's highways through national leadership, innovation, and program delivery.

As discussed above, pairing TPM with change management becomes critical to TPM implementation. A successful pairing involves elements of both *performance* and *change* management philosophies.

Two examples of *performance* management philosophies include:

- **The Shingo Model:** This model, as illustrated in Figure A-1 below, is depicted as a pyramid with four levels, the foundation of which is Cultural Enablers such as "Lead with humility" and "Respect every individual," and ascending levels being Continuous Improvement, Enterprise Alignment, and Results.[3]

Figure A-1: Shingo Pyramid Model

Source: Shingo Institute[4]

- **Model of High Performing Organizations:** Created by the Center for Innovative Cultures at Westminster College and includes elements such as "Distribute and use existing knowledge and new learning throughout the organization," "Walk the talk, especially leaders," and "Offer a strategic narrative that allows all organizational members to understand the impact of their contributions."[5]

  The Center points out that the vast majority of the American workforce is not actively engaged in its work, and therefore unable to reach their full potential. Citing a Gallup poll that estimates the cost to American corporations of "active disengagement" at $450 to $550 billion annually, the Center suggests that "the complexity and speed of change that organizations now face is stressing their capacity to adapt." It

[2] Federal Highway Administration. (2016). About Page. https://www.fhwa.dot.gov/about/. Retrieved 13 June 2016.
[3] The Shingo Institute. (2016). The Shingo Model™ is not just another initiative; it is a new way of thinking. http://www.shingoprize.org/model. Retrieved 13 June 2016.
[4] Shingo Institute. (2016). Shingo Model - 23 June 2016. Logan, UT. http://www.shingoprize.org/model
[5] Center for Innovative Cultures. (2016). How it Began. http://www.innovativecultures.org/new-page-1/. Retrieved 13 June 2016.

suggests that performance can be approved and strategic competitive advantage achieved by strengthening an organization's ability to change and adapt.[6]

The ability to adapt to a performance-driven culture should not be underestimated. Quantifying organizational performance can represent a new way of thinking. Applying metrics to individual performance can feel threatening, as if challenging staff to justify their position within the organization. A change management approach helps employees better understand the purpose of changes in their job roles, processes, and even use of technology. Select examples of *change* management philosophies include:

- The ADKAR model was developed by Prosci to represent five levels an individual must achieve for change management to be successful:[7]
  - **Awareness**. Employees must recognize the business reasons for change. Awareness occurs as the result of early communications related to an organizational change and helps individuals understand the impact change will have on them.
  - **Desire.** Once an employee recognizes the business reasons for change, it falls to leadership to help cultivate desire and ownership of change among key staff. By managing resistance to change through active listening and sincere appreciation for staff concerns, leaders can better encourage engagement and participation by employees in the change process.
  - **Knowledge.** The first two levels established a readiness for and acceptance of change. Knowledge teaches the individual how to change. It is the outcome of training and coaching and enables employees to realize or implement the change themselves at the required performance level.
  - **Ability.** The ability of a single individual or of a team to effect change in an organization is nurtured through coaching, practice, and patience. *Knowing* how to change is important, but learning how to drive change is essential.
  - **Reinforcement**. Not all levels of ADKAR are achieved in an initial pass by all individuals. Acknowledging and celebrating successful behavior or performance helps demonstrate what successful change management looks like, not only to the change agent but to the groups in which he or she operates. Both positive reinforcement and corrective action can help ensure change sticks.
- Colorado DOT leveraged Prosci's ADKAR and other change management practices in creating a Change Agent Network (Figure A-2) within the DOT. Individuals throughout the DOT, all with existing operational responsibilities, fill three key roles within the Change Agent Network:
  - **Change Agents**. These individuals are located strategically throughout the organization to geographically represent a group of CDOT staff. Headquarters frequently deployed two change agents while each of CDOT's five engineering regions hosted at least one.
  - **Change Leaders.** Change leads are usually assigned for a specific, large change initiative and help ensure open and frequent communication about the initiative through the change agents and thus to a broader audience. Members of the project team usually feel invested in the change, but a far greater number of staff would be impacted by the change without directly influencing it. Change leaders, therefore, are tasked with collaborating with change agents to develop newsletters, web pages, and other communication devices for the benefit of the entire organization.
  - **Sponsors**. Supervisors and senior executives who oversee project managers or champions of change initiatives are called upon as sponsors to assign change priorities, allocate resources to support those priorities, and keep change moving forward. Their purpose is not to enforce change but rather to foster an environment that readily accepts it.

[6] Center for Innovative Cultures. (2016). How it Began. http://www.innovativecultures.org/new-page-1/. Retrieved 13 June 2016.
[7] Prosci. (2016). What is Change Management? https://www.prosci.com/change-management/what-is-change-management. Retrieved 13 June 2016.

Figure A-2: Colorado DOT Modified ADKAR Model

Source: Climbing the Mountain to Success[8]

SUBCOMPONENTS AND IMPLEMENTATION STEPS

Figure A-3: Subcomponents for Organization and Culture

Source: Federal Highway Administration

The successful pairing of TPM with change management obviously requires more than a revision to the organizational chart or a refining of employee job descriptions. To truly drive performance in an organization, the agency must understand how to prioritize its goals and how to manage any constraints that might prevent it from achieving them. The Organization and Culture component is broken down into four subcomponents as illustrated in Figure A-3:

- **Leadership Team Support:** Demonstrated support by senior management and executive leadership for transportation performance management.
- **Roles and Responsibilities:** Clearly designated and resourced positions to support transportation performance management activities. Employees are held accountable for performance results.
- **Training and Workforce Capacity:** Implementation of activities that build workforce capabilities required for transportation performance management.
- **Management Process Integration:** Integration of performance data with management processes as the basis of accountability for performance results.

[8] Colorado Department of Transportation. (2015). Climbing the Mountain to Success. http://www.change-management.com/Prosci%20CDOT%20Webinar%20Slides.pdf.

Implementation steps, listed in Table A-1, for each of the subcomponents will help an agency create a transportation performance management culture by 1) building support among leaders by making the case for why transportation performance management is important, 2) assessing changes needed in the agency's organizational structure and positions, 3) identifying and closing gaps in employee skills required for transportation performance management success, and 4) linking employee activities to strategic goals and objectives to improve performance results.

Table A-1: Organization and Culture Implementation Steps

Source: Federal Highway Administration

Leadership Team Support	Roles and Responsibilities	Training and Workforce Capacity	Management Process Integration
1. Evaluate how new agency processes have been implemented previously	1. Assess current organizational structure	1. Identify gaps in employee skillsets	1. Incorporate performance discussions into regular management meetings
2. Develop TPM pitch	2. Define and document TPM roles and responsibilities	2. Design, conduct, and refine training program	2. Link employee actions to strategic direction
3. Clarify role of senior and executive management	3. Identify and implement changes to organizational structure	3. Build agency-wide support for TPM	3. Regularly set expectations for employees through measures and targets

CLARIFYING TERMINOLOGY

Table A-2 presents definitions for the organization and culture terms used in this guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table A-2: Organization and Culture: Defining Common TPM Terms

Source: Federal Highway Administration

Common Terms	Definition	Example
Activity	Refers to actions taken by transportation agencies, such as projects, related to strategy implementation.	Paving key locations, adding new guardrail, rehabilitating a bridge, purchasing new buses.
Change Management[9]	The discipline that guides how we prepare, equip and support individuals to successfully adopt change in order to drive organizational success and outcomes.	**Individual** change management requires understanding how people experience change and what they need to change successfully. **Organizational** change management provides steps and actions to take at the project level to support the hundreds or thousands of individuals who are impacted by a project. **Enterprise** change management is an organizational core competency that provides competitive differentiation and the ability to effectively adapt to the ever-changing world.
Goal	A broad statement of a desired end condition or outcome; a unique piece of the agency's vision.	A safe transportation system.
Mission	Statement that reflects the core functional purpose of an agency.	Plan, build, operate, and maintain a safe, accessible, efficient, and reliable multimodal transportation system that connects people to destinations and markets throughout the state, regionally, and around the world.[10]
Objective	A specific, measurable statement that supports achievement of a goal.	Reduce the number of motor vehicle fatalities.
Outcome	Results or impacts of a particular activity that are of most interest to system users. Focus of subcomponent 5.1 System Level Monitoring and Adjustment.	Transit travel time reliability, fatality rate, percent of assets within useful life.

[9] Prosci. (2016). What is Change Management? https://www.prosci.com/change-management/what-is-change-management. Retrieved 13 June 2016.

[10] Minnesota Department of Transportation (MnDOT). (2016). MnDOT's Vision. http://www.dot.state.mn.us/vision/. Retrieved 13 June 2016.

Common Terms	Definition	Example
Output	Quantity of activity delivered through a project or program. Focus of subcomponent 5.2 Program/Project Level Monitoring and Adjustment.	Miles of pavement repaved, miles of new guardrail put into place, the number of bridges rehabilitated, the number of new buses purchased.
Performance Measure	Performances measures are based on a metric that is used to track progress toward goals, objectives, and achievement of established targets. They should be manageable, sustainable, and based on collaboration with partners. Measures provide an effective basis for evaluating strategies for performance improvement.	Transit passenger trips per revenue hour.
Target	Level of performance that is desired to be achieved within a specific time frame.	Two % reduction in fatality rate in the next calendar year.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.
Vision statement	An overarching statement of desired outcomes that is concisely written, but broad in scope; a vision statement is intended to be compelling and inspiring.	Minnesota's multimodal transportation system maximizes the health of people, the environment, and our economy.[11]

[11] Minnesota Department of Transportation (MnDOT). (2016). MnDOT's Vision. http://www.dot.state.mn.us/vision/. Retrieved 13 June 2016.

RELATIONSHIP TO TPM COMPONENTS

The ten TPM components are interconnected and often interdependent. Table A-3 summarizes how each of the nine other components relate to the organization and culture component.

Table A-3: Organization and Culture Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to Organization and Culture
01. Strategic Direction	The establishment of an agency's focus through well-defined goals/objectives and a set of aligned performance measures.	The strategic direction drives employee activities by defining agency priorities that should be focused upon in day-to-day work.
02. Target Setting	The use of baseline data, information on possible strategies, resource constraints and forecasting tools to collaboratively set targets.	Agency targets define success for the agency, and lay the foundation for setting work group and individual employee targets.
03. Performance-Based Planning	Use of a strategic direction to drive development and documentation of agency strategies and priorities in the long-range transportation plan and other plans.	A shift in organizational structure, workforce training, and change management at the agency enable performance-based planning processes to be completed sustainably.
04. Performance-Based Programming	Allocation of resources to projects to achieve strategic goals, objectives and performance targets. Clear linkages established between investments made and their expected performance outputs and outcomes.	A shift in agency culture allows performance-based processes to be integrated into existing programming activities; the elements of the organization and culture component support this integration.
05. Monitoring and Adjustment	Processes to monitor and assess actions taken and outcomes achieved. Establishes a feedback loop to adjust programming, planning, and benchmarking/target setting decisions. Provides key insight into the efficacy of investments.	Because this component is newly called out by the TPM framework, skill development and training related to Monitoring and Adjustment will be especially important.
06. Reporting and Communication	Products, techniques, and processes to communicate performance information to different audiences for maximum impact.	This component promotes skill development and leadership support for improved performance reporting.
B. External Collaboration and Coordination	Established processes to collaborate and coordinate with agency partners and stakeholders on planning/visioning, target setting, programming, data sharing, and reporting.	To be successful in external collaboration activities in support of transportation performance management, agency staff must be successful at internal TPM activities; subcomponents of this component enable effective integration.
C. Data Management	Established processes to ensure data quality and accessibility, and to maximize efficiency of data acquisition and integration for TPM.	Similarly, staff must have the capability to manage data effectively for use in transportation performance management and integrate data into TPM processes.
D. Data Usability and Analysis	Existence of useful and valuable data sets and analysis capabilities, provided in usable, convenient forms to support TPM.	Staff must have access to usable data and have the skills necessary to analyze it; this component enables skill development.

REGULATORY RESOURCES

This Guidebook is intended only to assist agencies with implementing transportation performance management in a general sense and not to provide guidance on compliance and fulfillment of Federal regulations. However, it is important to consider legislative requirements and regulations when using the Guidebook. In many cases, use of this Guidebook will bring an agency in alignment with Federal requirements; however, the following sources should be considered the authority on such requirements:

Federal Highway Administration

- Transportation Performance Management: http://www.fhwa.dot.gov/tpm/links_fhwa.cfm
- Fact Sheets on Fixing America's Surface Transportation (FAST) Act: https://www.fhwa.dot.gov/fastact/factsheets/
- Fact Sheets on Moving Ahead for Progress in the 21st Century (MAP-21): https://www.fhwa.dot.gov/map21/factsheets/
- Resources on MAP-21 Rulemaking: https://www.fhwa.dot.gov/tpm/rule.cfm

Federal Transit Administration

- Fact Sheets on FAST Act: https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-fast-act
- Resources on MAP-21: https://www.transit.dot.gov/regulations-and-guidance/legislation/map-21/map-21-program-fact-sheets

IMPLEMENTATION STEPS

A.1 LEADERSHIP TEAM SUPPORT

This section will help an agency build leadership support for transportation performance management and communicate to leaders their roles and the benefits of TPM.

1. Evaluate how new agency processes have been implemented previously
2. Develop TPM pitch
3. Clarify role of senior and executive management

> "Strong leadership from a DOT's chief executive or senior management is almost always a defining factor in the success of any DOT's performance management initiative… agency leaders must set the tone."
>
> Source: NCHRP 660, TPM: Insight from Practitioners

STEP A.1.1	Evaluate how new agency processes have been implemented previously

Description

To improve the chances of positive reception by leadership, it is important to approach them with a clear plan and support for why transportation performance management is necessary for the organization to be successful. A good way to do this is to consider how new initiatives and processes have been implemented in the past and adopt techniques that were successful to implement transportation performance management processes. Conversely, past failures in implementation can give staff an idea of techniques to avoid.

> "We live in a world of constant change. Many times that change is driven by political turnover. Elections can bring in a new Governor who in turn changes transportation agency leadership. When you get new leadership in, it's like you are starting the performance management cycle all over again."
>
> - Christos Xenophontos, RiDOT

In surveying past successes and failures, the agency can begin to assess its readiness to accept future change. Readiness assessments can target the organization or enterprise, the work unit, the individual, the sponsor capacity, and even existing tools and processes. By asking the following questions, it can even address the magnitude of the change and its potential impact on the organization:[12]

- How big is this change?
- How many people are affected?
- Is it a gradual or radical change?

While the most appropriate techniques will vary by agency, some ideas include:

Identify and enlist champions/sponsors with access to leadership: Accessing leadership is sometimes difficult so it is important to identify champions who already have access to leadership who are willing to sponsor transportation performance management initiatives. While these champions are often one or two levels removed from the highest levels of leadership, they are experienced at moving and gathering support for new initiatives within the organization.

[12] Prosci. (2016). Change Management Process. https://www.prosci.com/change-management/thought-leadership-library/change-management-process. Retrieved 13 June 2016.

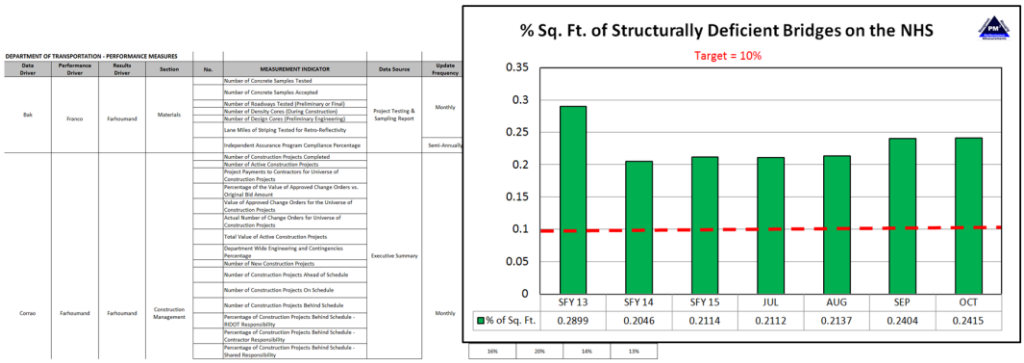
STEP A.1.1	Evaluate how new agency processes have been implemented previously
	Opportunistically communicate about TPM: Competition for time with leadership can be intense. Therefore, when reasonable, use other meetings with leadership to make the case for TPM. Transportation performance management can bring benefits to all aspects of the agency so it may make sense to continually relate back to these benefits in seemingly unrelated requests. Make the connection to between current issues and how TPM could address them. **Use Federal or state compliance as support:** Federal and state requirements often include provisions for performance measurement, reporting, or other TPM activities. Leadership must comply with these requirements; use the requirements as opportunities to communicate the benefits of a broader TPM practice to obtain support. **Demonstrate benefit over cost:** Break down the costs and benefits expected from transportation performance management to show monetary savings, improved performance results, or other benefits that will outweigh costs associated with implementation and transition. **Prepare for leadership change:** Elections occur frequently and often result in shifts of political leadership, which affect agency leadership and priorities. Agencies must prepare for this because it will happen. By preparing, staff documents standard operating procedures that transition TPM activities into standard practices. These documented standard operating procedures can then be used to brief new leadership and staff, thus institutionalizing TPM practices within the organization's business processes.
Examples	**Utah Transit Authority (UTA): Highlighting Past Successes** Staff at UTA has found that championing past success is a proven tool for building support for transportation performance management processes. Often staff is undertaking transportation performance management practices in small ways but does not realize it or call it by that name. These practices often lead to positive results, which can then be used to make the connection to why those results occurred, i.e., because TPM practices were employed. UTA, through examination of its transit vehicle crash data, found that new operators and right-side clearance in downtown construction zones resulted in a large number of crashes. To improve results, the agency addressed these problems by instituting new training procedures. Staff was then able to make the connection between the data collected, the adjustments made, and the improvement that resulted. UTA used this example to further promote TPM within the agency. When leadership realizes that TPM is already being practiced and it is producing results, they are more likely to embrace TPM. **RiDOT: Celebrate Early Wins to Promote TPM** When the Rhode Island Department of Transportation (RiDOT) first began to integrate transportation performance management processes, the agency was able to celebrate a major milestone: a member of the executive leadership team requested a quarterly performance report to use in a new meeting to review performance trends. In the meetings, the executive used the performance report to discuss with managers ways to use the results to improve. This

STEP A.1.1	Evaluate how new agency processes have been implemented previously

was a clear demonstration of support by leadership. As a result, the managers understood the wealth of information available to them because it was included in the report. By celebrating this early win of executive support, RiDOT was able to make clear to staff that leadership saw the benefits of connecting performance information to daily activities.

Figure A-4: RiDOT Performance Report

Source: RiDOT[13]



Linkages to Other TPM Components	Component 01: Strategic Direction Component B: External Collaboration and Coordination (See TPM Framework)

STEP A.1.2	Develop TPM pitch

Description

Once the change agents, leaders, and sponsors for TPM have helped determined readiness for the new initiative, the benefits of implementation, and the potential barriers to success, they must develop a communication plan or "TPM Pitch."

A common trap for change leaders at any level of the organization is the belief that their work is complete once they have delivered a compelling argument for change. Rather, the job has only started. Not only must their argument or message be repeated consistently and clearly to those impacted, but the feedback must be openly accepted and managed. Prosci offers three key components to an effective change communication pitch/plan:[14]

- The audience
- What is communicated
- When it is communicated

The pitch should be tailored to each audience based on its area of responsibility and the performance challenges faced within that area of responsibility. This is a great way to make the direct benefits clear to the organization and demonstrate how transportation performance management processes can lead to improved results within each leader's area of

[13] Rhode Island Department of Transportation. (2016). Performance Report. Providence, RI.
[14] Prosci. (2016). Change Management Process. https://www.prosci.com/change-management/thought-leadership-library/change-management-process. Retrieved 13 June 2016.

STEP A.1.2	Develop TPM pitch

responsibility. It is advantageous to identify champions among the leadership who will promote the idea to other leaders. If no champion exists, focus the pitch on leaders who seem open to new ideas and develop them into champions.

Keep the pitch short and focused on the most important elements of transportation performance management and the resulting benefits to the individual you are targeting. These are often called elevator pitches because they should take no more time than an elevator ride.

- Make the case for the most critical and doable processes/integration:
  - Some changes should be implemented together to achieve the full benefits of the change; consider connections across strategic changes to take full advantage.
  - Which change will provide the greatest benefit for the least amount of resources?
- Prioritize what is most likely to be supported by the individual or leadership as a whole:
  - Who are the opinion leaders among the executive team?
  - Consider who will be directly involved with implementing the change—they must be supportive and willing to commit resources.[15]

> "Our first attempt to implement 4 or 5 years ago didn't succeed because the information wasn't perceived as valuable by the decision makers and therefore nobody paid any attention to it even though there was a good structure in place. This time we are determined to change TPM from a management exercise to the way TxDOT does business."
>
> - Tonia Norman, TxDOT

Even after initial TPM processes have been implemented, staff will likely need support to encourage wider adoption. Make leadership aware of successes that can be traced back to transportation performance management processes to promote further progress.

Sometimes leadership will support the idea of transportation performance management but be unable to provide resources to actually implement changes. Be persistent and persuasive, and work to implement reforms using existing resources.

Examples

FHWA: Talking Points for FHWA Leadership

When the Federal Highway Administration (FHWA) began to roll out its strategy for implementing transportation performance management, they provided a set of talking points to senior leadership to champion the message and pitch TPM to FHWA's partner agencies. Below is an excerpt taken from those talking points:[16]

The FHWA Role:

- **"Stewardship Heavy – Oversight Light":** Our emphasis should be on providing

[15] National Cooperative Highway Research Program. (2015). The Role of Planning in a 21st Century State Department of Transportation—Supporting Strategic Decisionmaking. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_798.pdf. *NCHRP Report 798*. Washington, DC. Retrieved 13 June 2016.

[16] FHWA (2015). Implementation of MAP-21 Performance Provisions Talking Points for FHWA Leadership.

STEP A.1.2	Develop TPM pitch

effective stewardship and not focused on the "stick" we can wield through compliance oversight. We should be engaged in helping our partners through this evolution, making sure they understand what the rulemaking requires and how to implement and accomplish this. It will require much collaboration and learning, both by our partners and by FHWA.

- **Success = 100 Percent Compliance:** We will build on our successful experience with the American Recovery and Reinvestment Act (ARRA) in working hard with our partners on the front end. While this will not be a rubber stamp process, our goal is for all our partners to be able to fully comply.

How We Get There:

- **States and Metropolitan Planning Organizations (MPOs) are Our Partners:** We need to understand where they are regarding transportation performance management, what their capabilities are, and how what is being proposed is different from what State DOTs and MPOs are doing today. Divisions play a key role, with assistance from Headquarters and the resource center.
- **Deliver in a Consistent Manner:** Communication and coordination between the divisions and Headquarters is critical. FHWA must bring transportation performance management together as a whole, not just safety performance or infrastructure performance or system performance. The MAP-21 performance elements are cross cutting and pulled together through a collaborative planning and programming process. Communication within FHWA across disciplines and units will be critical to our success in implementation.
- **Get a Seat at the Table at the Local Level:** Divisions should strive to be a partner at the table to work with our partners as they make good, results-oriented, investment decisions that will maximize the return of the public investment in our transportation system. This is a prime opportunity for FHWA to bring technological and programmatic leadership to the discussion as the State DOTs and MPOs work through the decisions they must make. We need to build our strength so that they look to us as a resource and as a partner. We will be a broker of knowledge.

Top Five Implementation Opportunities:

Optimizing Investments of Public Funds

- Transportation funding is limited, so we must maximize the return on the investment of the public dollars entrusted to transportation agencies and planning organizations.
- Better decisions, made with the overall system performance in mind, will result in the best "mix" of investments that will collectively maximize the performance gains of the system.

Improving Consistency Across the Country

- Many states already are involved in decision-making transportation performance management today. Consistency in terminology, standards, and metrics will result in an easier transfer of knowledge so that we can hold an effective national conversation on transportation performance and develop valuable national performance reports.
  We will strive for measures that can be implemented and that are meaningful rather than the lowest common denominator. The easiest measure is not necessarily the best.

STEP A.1.2	Develop TPM pitch
	Increasing Coordination of Decision-Makers • State DOTs, MPOs, transit agencies, local governments, and others all share in the responsibility to support national performance needs through their local decision-making. • The planning process, a tool that already exists, is a key part of successful coordination. We will build on what is already working there. **Increasing Our Understanding of What Works** • This is a critical role for FHWA: What investment strategies are useful in achieving the targets set and the desired outcomes? • While we have some knowledge today though our existing data tools, the transportation performance management process provides us with an opportunity to develop that knowledge base even further with our partners. **Communicating Federal Investment Returns** • Without a common set of metrics and national reporting, we are challenged today in being able to effectively report on the outcomes of transportation investments and the impact of the $40B annual Federal investment on our nation's highways. • The story we need to tell is not only what we are able to do but also what we are unable to do with existing resource constraints. This will inform discussions on future authorizations and Federal funding levels.
Linkages to Other TPM Components	Component 06: Reporting and Communication (See TPM Framework)

STEP A.1.3	Clarify role of senior and executive management
Description	While developing the communication pitch/plan can be accomplished by the change management team's agents and leads, executives play a critical sponsor role in times of change. The supervisor of a work group can, in fact, have the greatest influence over his or her subordinates' approach to change. The change management team must therefore also develop a plan for sponsor activities so that executive management can effectively carry out these plans. Research shows that sponsorship is the most important success factor in change management.[17] "You have to connect the technical side to internal management practices and concerns of elected officials." - Monique de los Rios-Urban, Maricopa Association of Governments Staff should be prepared to help define what senior management and leadership should do to promote transportation performance management. Without specifics concerning what is

[17] Prosci. (2016). Change Management Process. https://www.prosci.com/change-management/thought-leadership-library/change-management-process. Retrieved 13 June 2016.

STEP A.1.3	Clarify role of senior and executive management
	expected from them, many on the leadership team will not commit to a change agenda.[18] Effective sponsorship may involve the following activities: • Active and visible participation in the implementation of TPM • Demonstrated leadership support at agency meetings and presentations to key audiences[19] • Strong coordination among other leaders to help ensure message consistency among employees • Consistent and regular use of performance information and language, including impactful graphics that clearly demonstrate performance • Incorporation of performance data and reports within presentations on other topics [20] • Alignment of resources including funding and staffing to best support TPM implementation[21]
Examples	**Utah DOT: Leadership's Role** The Utah Department of Transportation (UDOT) has successfully implemented many aspects of transportation performance management. Implementation was a byproduct of the UDOT Transportation Asset Management Plan (TAMP), which included a roadmap for integrating programs, tracking performance data, and organizing and making such data accessible. Implementation included identifying high-level risks to certain assets, developing a framework around those risks to improve the economy of a specific asset, and then setting a prioritized funding structure. However, full implementation of the TPM procedures will not be complete until UDOT has reached the end of its first five-year period within its overarching TAMP. Because risks may not be immediately identifiable, using a five-year period to monitor the performance of roads and pavement will better allow UDOT to make informed funding decisions with regard to risk.[22] UDOT credits its success in part to leadership support including the following:[23] • Executive level leadership articulated a strategic direction. Management set goals and targets aligned with the strategic direction. • Leadership at all levels laid a cultural foundation by demonstrating a clear vision for the agency. • TPM has been integrated into decision making by all managers. • Past DOT leadership has encouraged a culture where employees fully understood strategic goals and had the flexibility to innovate to pursue the goals.

[18] National Cooperative Highway Research Program. (2015). The Role of Planning in a 21st Century State Department of Transportation—Supporting Strategic Decisionmaking. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_798.pdf. *NCHRP Report 798*. Washington D.C.
[19] National Cooperative Highway Research Program. (2010). Transportation Performance Management: Insight from Practitioners. *NCHRP Report 660*. Washington, DC. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf. Retrieved 13 June 2016.
[20] National Cooperative Highway Research Program. (2010). Transportation Performance Management: Insight from Practitioners. *NCHRP Report 660*. Washington, DC. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf. Retrieved 13 June 2016.
[21] National Cooperative Highway Research Program. (2010). Transportation Performance Management: Insight from Practitioners. *NCHRP Report 660*. Washington, DC. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf. Retrieved 13 June 2016.
[22] Utah Department of Transportation. (2016). Utah Transportation Asset Management Plan. https://www.udot.utah.gov/public/ucon/uconowner.gf?n=15892110208531307. Retrieved 15 June 2016.
[23] Transportation Research Board. (2014). Performance Management in Practice. *TR News No. 293*. http://onlinepubs.trb.org/onlinepubs/trnews/trnews293.pdf. Retrieved 13 June 2016.

STEP A.1.3	Clarify role of senior and executive management

Figure A-5: Utah DOT Logo

Source: Utah DOT[24]

Michigan DOT: Building Political Support

A key role or activity of senior executives is the alignment of resources, including funding and staffing, to best support TPM implementation. Michigan state legislators have strict term limits, which means elected officials are often new and not familiar with the needs of the DOT. To educate them about the major backlog of projects and the need for increased funding to complete them, the CEO and his staff meet with each new legislator and make presentations at town hall meetings statewide. Agency staff also built a simplified funding model that allows the CEO to quickly show the impact of a legislator's ideas and funding levels on system performance. All of these efforts have been effective at moving the dialogue with legislators from *whether* the state's transportation system needs more funding to *how much more* it needs and where to find the money. As an interim solution, the legislature invested $350 M in general fund revenue, an unprecedented amount.[25]

Linkages to Other TPM Components		
	Component 06: Reporting and Communication	(See TPM Framework)
	Component B: External Collaboration and Coordination	

[24] Utah Department of Transportation. (2016). Logo. Taylorsville, UT.
[25] Transportation Research Board. (2014). Performance Management in Practice. *TR News No. 293*. http://onlinepubs.trb.org/onlinepubs/trnews/trnews293.pdf. Retrieved 13 June 2016.

A.2 ROLES AND RESPONSIBILITIES

The steps in this section focus on identifying and making changes to the agency's organizational structure to better support transportation performance management and to ensure TPM practices are sustainable.

1. Assess current organizational structure
2. Define and document TPM roles and responsibilities
3. Identify and implement changes to organizational structure

> "Organizational change is really about communicating new expectations for how work should be done and holding people accountable for implementing those new expectations. Change only occurs when the people who are responsible for executing the day-to-day processes actually implement new procedures."
>
> Source: NCHRP 798, The Role of Planning in a 21st Century State DOT—Supporting Strategic Decisionmaking

STEP A.2.1	Assess current organizational structure
Description	Transportation performance management will be most successful if the organizational structure of the agency is conducive, and it is likely that changes will need to be made to better align with new roles and responsibilities required by transportation performance management processes. Many agencies operate within departmental and modal silos, which limit the chances for transportation performance management to take hold, or spread from within the confines of a silo. Making progress toward strategic goals is easier when information is shared and strategies are coordinated to capitalize on efficiencies and take advantage of synergy between projects. It's also easier when the organization understands the importance of broader organizational change rather than merely individual change. Organizational change management identifies the groups and people who will need to initiate, embrace, or simply accept TPM. It also clarifies in what ways those groups will need to change. Organizational change management helps to ensure that impacted employees receive the support they need to change successfully. Successful implementation of TPM can be achieved even if all performance targets are not. Accepting a new practice of target setting for project delivery, for example, may signify a significant shift toward transportation performance management even if the actual project delivery target is not initially achieved. Organizational change management, therefore, is complementary to instilling TPM. The TPM leads ensure the initiative is properly tailored for and delivered to the organization while change agents and leads enable TPM to be effectively embraced, adopted, and used. **The first step in making these changes is assessing the agency's current organizational structure:** • Does the current organizational structure support a transportation performance management framework? • Does staff have the ability to use performance data in their daily activities? Often, these data are only accessible by finance office staff. • Do they have the capacity to integrate transportation performance management activities into their existing workload, or will new staff be needed?

STEP A.2.1	Assess current organizational structure

Examples

North Carolina Department of Transportation

The DOT underwent a wholesale assessment by McKinsey and Company to determine how to function more like a private company in terms of efficiency and performance. This process was supported by management, the Governor, and the Legislature. The assessment included town hall meetings with and surveys of employees. One category of findings included issues with organizational elements, and organizational silos were specifically called out: key processes such as project delivery were too siloed, and lacked the units needed to support others such as intermodal and strategic planning. The assessment also found that operational processes lacked metrics-based management that cascaded to all levels of staff.[26]

To address these issues and others, the DOT developed five initiatives to implement improvements:

- Strategic direction
- Planning and prioritization
- Program and project delivery
- Human resource management
- Performance and accountability

Figure A-6: North Carolina DOT Logo

Source: North Carolina DOT[27]

These initiatives were completed in order; identifying a strategic direction involved crafting vision and mission statements and developing strategic goals. In the second initiative, the DOT created a strategic planning office to ensure investments were data-driven. The office has developed a method for scoring and prioritizing projects. Other improvements include a streamlined hiring process and implementation of mentoring programs to retain high-performing employees. Additionally, the agency reduced data sets from 1000 to 400 in two years, partly by integrating data that applied to more than one business unit.

Results of the initiatives include improved:

- Employee performance ratings: 75-80% now meeting expectations.
- Project delivery: delivering 75% of programmed projects as of 2012.
- Asset condition: in 2012, 66.2% of bridges were in good condition, and the average highway feature condition score was 89.7 (target was 84).

Lessons learned include:

- Don't move too quickly. Major change is stressful and employees need time to adapt.
- Building relationships across divisions and tying success to employee performance were critical to making staff feel valued.
- Encourage employee feedback. NCDOT amended performance evaluations based on employee feedback.[28]

[26] AASHTO. (2010). A CFO's Handbook on Performance Management. *Transportation Finance Briefing Papers*. http://www.transportation-finance.org/pdf/0211_performance_management_briefing_paper.pdf. Washington, DC. Retrieved 13 June 2016.
[27] North Carolina Department of Transportation. (2016). Logo. Raleigh, NC.
[28] Federal Highway Administration. (2013). North Carolina DOT: Development of a Performance Management System. *FHWA Transportation Performance Management Case Study*. http://www.fhwa.dot.gov/tpm/resources/docs/nc_casestudy.pdf. Retrieved 13 June 2016.

STEP A.2.1	Assess current organizational structure
Linkages to Other TPM Components	All (See TPM Framework)

STEP A.2.2	Define and document TPM roles and responsibilities
Description	Staff should define what roles and responsibilities will be necessary for transportation performance management processes and clearly document them. This should include not only those required for completion of transportation performance management activities, but also those required for initial creation and integration of TPM processes as well as ongoing support to ensure sustainability and long-term staying power. Agency approaches to organizational structures vary. Some create standalone transportation performance management offices with dedicated staff that work with other staff throughout the organization. Others use a matrix structure, where a transportation performance management staff member is located within departments or offices and works closely with staff there but also with other transportation performance management staff in other work groups. Yet another approach is to integrate transportation performance management activities across existing staff, though possibly with adjusted relationships.[29] Some agencies find that the more individuals are involved in TPM, the more ownership they have, which produces positive results. Documentation of these roles and responsibilities will ensure the agency can reevaluate changes at intervals, as transportation performance management matures. It will also assist staff in identifying what changes to make in step A.2.3, by comparing to the assessment of the existing organizational structure completed in step A.2.1.
Examples	**Hampton Roads Transportation Planning Organization (HRTPO)** HRTPO has set up a schedule to clearly identify which employees are responsible for which activities. The image below shows a part of this work schedule, which includes project tasks on the left, cycle (annual, quarterly, etc.), which employee serves as principal, and which employees assist. The final columns are a schedule of work by quarter and the month in which all work on the particular project should be completed. HRTPO leadership sought to simplify agency work by clearly documenting it for staff to see, which also enables collaboration and coordination. Leadership meets with principals each Monday to discuss work to be done that week and to review progress; in turn, principals meet with their staff. Accountability for results is maintained through this weekly set of meetings. Principals are typically planners or engineers and lead teams for public involvement, congestion management, development of the LRTP, programming, and others.

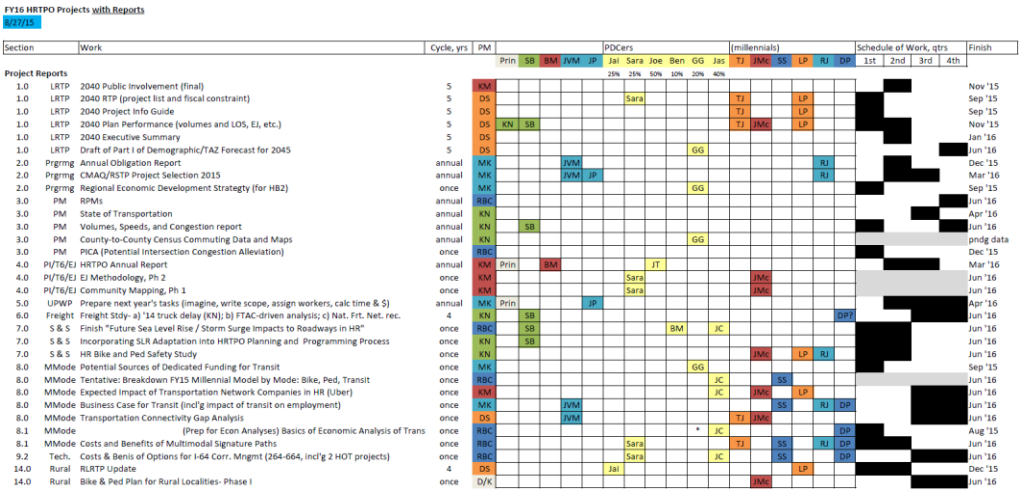
[29] National Cooperative Highway Research Program. (2015). The Role of Planning in a 21st Century State Department of Transportation — Supporting Strategic Decisionmaking. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_798.pdf. *NCHRP Report 798*. Washington D.C.

STEP A.2.2	Define and document TPM roles and responsibilities

The schedule is linked to the Unified Planning Work Program[30] that further documents tasks to be completed and how transportation performance management is woven into these tasks.

Figure A-7: HRTPO Unified Planning Work Program Schedule

Source: Unified Planning Works Program[31]



FY16 HRTPO Projects with Reports

9/27/15

Section		Work	Cycle, yrs	PM	Prin	SB	BM	JVM	JP	Jai	Sara	Joe	Ben	GG	Jas	TJ	JMc	SS	LP	RJ	DP	1st	2nd	3rd	4th	Finish
Project Reports										25%	25%	50%	10%	20%	40%											
1.0	LRTP	2040 Public Involvement (final)	5	KM																						Nov '15
1.0	LRTP	2040 RTP (project list and fiscal constraint)	5	DS							Sara					TJ			LP							Sep '15
1.0	LRTP	2040 Project Info Guide	5	DS												TJ			LP							Sep '15
1.0	LRTP	2040 Plan Performance (volumes and LOS, EJ, etc.)	5	DS		KN	SB									TJ	JMc		LP							Nov '15
1.0	LRTP	2040 Executive Summary	5	DS																						Jan '16
1.0	LRTP	Draft of Part I of Demographic/TAZ Forecast for 2045	5	DS										GG												Jun '16
2.0	Prgrmg	Annual Obligation Report	annual	MK				JVM												RJ						Dec '15
2.0	Prgrmg	CMAQ/RSTP Project Selection 2015	annual	MK				JVM	JP											RJ						Mar '16
2.0	Prgrmg	Regional Economic Development Strategy (for HB2)	once	MK										GG												Sep '15
3.0	PM	RPMs	annual	RBC																						Jun '16
3.0	PM	State of Transportation	annual	KN																						Apr '16
3.0	PM	Volumes, Speeds, and Congestion report	annual	KN		SB																				Jun '16
3.0	PM	County-to-County Census Commuting Data and Maps	annual	KN										GG												pndg data
3.0	PM	PICA (Potential Intersection Congestion Alleviation)	once	RBC																						Dec '15
4.0	PI/T6/EJ	HRTPO Annual Report	annual	KM	Prin		BM					JT														Mar '16
4.0	PI/T6/EJ	EJ Methodology, Ph 2	once	KM							Sara						JMc									Jun '16
4.0	PI/T6/EJ	Community Mapping, Ph 1	once	KM							Sara						JMc									Jun '16
5.0	UPWP	Prepare next year's tasks (imagine, write scope, assign workers, calc time & $)	annual	MK	Prin				JP																	Apr '16
6.0	Freight	Freight Stdy- a) '14 truck delay (KN); b) FTAC-driven analysis; c) Nat. Frt. Net. rec.	4	KN		SB															DP?					Jun '16
7.0	S & S	Finish "Future Sea Level Rise / Storm Surge Impacts to Roadways in HR"	once	RBC		SB							BM		JC											Jun '16
7.0	S & S	Incorporating SLR Adaptation into HRTPO Planning and Programming Process	once	KN		SB																				Jun '16
7.0	S & S	HR Bike and Ped Safety Study	once	KN													JMc		LP	RJ						Jun '16
8.0	MMode	Potential Sources of Dedicated Funding for Transit	once	MK										GG												Sep '15
8.0	MMode	Tentative: Breakdown FY15 Millennial Model by Mode: Bike, Ped, Transit	once	RBC											JC			SS								Jun '16
8.0	MMode	Expected Impact of Transportation Network Companies in HR (Uber)	once	KM											JC		JMc		LP							Jun '16
8.0	MMode	Business Case for Transit (incl'g impact of transit on employment)	once	MK				JVM										SS		RJ	DP					Jun '16
8.0	MMode	Transportation Connectivity Gap Analysis	once	DS				JVM								TJ	JMc									Jun '16
8.1	MMode	(Prep for Econ Analyses) Basics of Economic Analysis of Trans	once	RBC										*	JC						DP					Aug '15
8.1	MMode	Costs and Benefits of Multimodal Signature Paths	once	RBC							Sara					TJ		SS		RJ	DP					Jun '16
9.2	Tech.	Costs & Benis of Options for I-64 Corr. Mngmt (264-664, incl'g 2 HOT projects)	once	RBC							Sara				JC			SS			DP					Jun '16
14.0	Rural	RLRTP Update	4	DS						Jai									LP							Dec '15
14.0	Rural	Bike & Ped Plan for Rural Localities- Phase I	once	D/K													JMc									Jun '16

Missouri DOT Tracker

The Tracker report is a much-lauded performance reporting product that also serves as documentation of transportation performance management responsibilities within the agency. The report includes a significant number of performance measures and each one is clearly linked to particular employees called Result Drivers and Measurement Drivers. This is a simple way to document important responsibilities for performance data collection and reporting, as well as accountability for results.

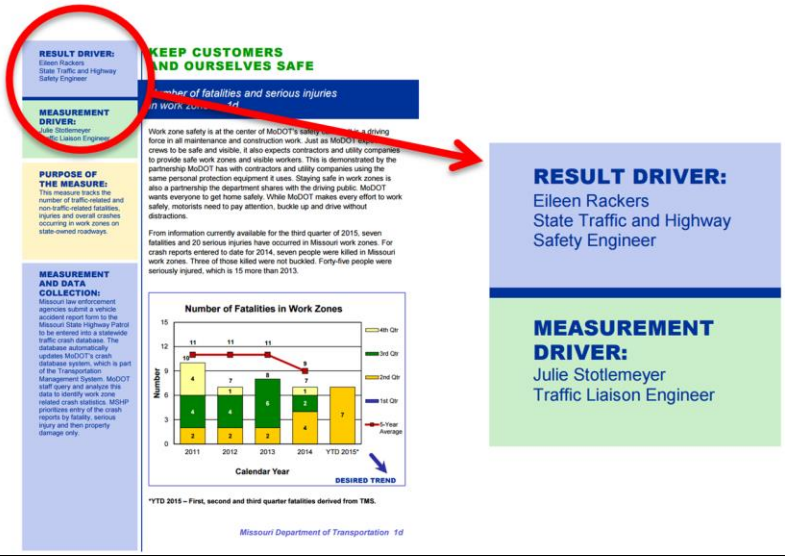
[30] Hampton Roads Transportation Planning Organization. (2014). Unified Planning Work Program, FY2015. http://www.hrtpo.org/uploads/docs/FY2015%20HRTPO%20UPWP.pdf. Retrieved 13 June 2016.

[31] Missouri Department of Transportation. (2016). Tracker: Measures of Departmental Performance. Jefferson City, MO. http://www.modot.org/about/documents/April2016Tracker.pdf

STEP A.2.2	Define and document TPM roles and responsibilities

Figure A-8: Missouri DOT Tracker

Source: MoDOT[32]



Linkages to Other TPM Components	All (See TPM Framework)

STEP A.2.3	Identify and implement changes to organizational structure

Description

Using the assessment of the current organizational structure and the documented roles and responsibilities needed for transportation performance management, identify changes to make and implement them. A critical aspect of this process is communicating changes to staff who will be impacted. They will be concerned about increases in workload, changes in their activities, and their job security.

Leadership should clearly communicate:

- What is changing
- Why it's changing
- What it means for the individual, including expectations, responsibilities, and benefits
- What impact it will have on performance, the agency, and outcomes
- What things will look like when the dust has settled

> "Sometimes the job requires you to be an amateur psychologist."
>
> - David King, GM, Triangle Transit

There will be resistance among some staff simply because many have been doing things one way for a long time and adapting to change will take time and effort. Others will resist because they see an increase in work or cannot see the importance of the change or fear a loss of

[32] Missouri Department of Transportation. (2016). Tracker: Measures of Departmental Performance. Jefferson City, MO. http://www.modot.org/about/documents/April2016Tracker.pdf

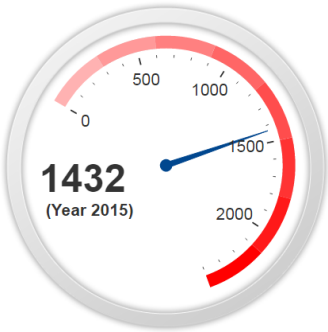
STEP A.2.3	Identify and implement changes to organizational structure
	control of data or a process.[33] Leadership should try to address these concerns in a reasonable way, while also making clear that changes will come regardless. However, leadership has a responsibility to listen to concerns of staff to ensure that changes are reasonable. Early adopters within work groups can be highlighted to encourage others during this time of culture shift. **Consider the following changes:** • Improve coordination for short-, mid-, and long-range planning and decision-making by facilitating discussions among DOT offices and divisions • Work to remove silos by facilitating a holistic performance-based planning approach that coordinates asset management, operational improvements, targeted construction improvements, and funding for all modes • Identify duplicative efforts in data collection and analysis that can be consolidated to save limited funding and staff resources.[34] Consider giving all employees direct access to performance data.[35] Planning for skills transfer and training should follow soon after the establishment of TPM processes (see subcomponent A.4). The agency should also periodically refine roles and responsibilities as transportation performance management processes are improved or as new processes and noteworthy practices are developed.
Examples	**Georgia DOT: Instituting Changes** The Georgia DOT's transportation performance management office created a public dashboard that included measures and targets. Because this was a new product and a new way of doing things at the agency, there was a need to educate staff on transportation performance management terminology and practices. Weekly meetings were held to discuss measure and target pairs one by one; this method ensured that staff understood the changes that were taking place. With weekly meetings complete, the transportation performance management office was able to then hold group meetings with program offices to sort 40 overall agency measures into 14 global measures that drive decision-making and funding allocations.

[33] National Cooperative Highway Research Program. (2015). The Role of Planning in a 21st Century State Department of Transportation — Supporting Strategic Decisionmaking. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_798.pdf. *NCHRP Report 798*. Washington D.C.
[34] National Cooperative Highway Research Program. (2015). The Role of Planning in a 21st Century State Department of Transportation — Supporting Strategic Decisionmaking. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_798.pdf. *NCHRP Report 798*. Washington D.C.
[35] National Cooperative Highway Research Program. (2010). Transportation Performance Management: Insight from Practitioners. *NCHRP Report 660*. Washington, DC. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf. Retrieved 13 June 2016.

STEP A.2.3	Identify and implement changes to organizational structure

Figure A-9: Georgia DOT Dashboard
Source: GDOT Performance Dashboard[36]

Number of Fatalities Annually on Georgia's Roadways



Description

GDOT considers safety in every stage of a project and in every investment decision. The American Association of State Highway and Transportation Officials (AASHTO) have adopted a national goal of reducing fatalities by 1000 each year. To assist in achieving this national goal, Georgia has set a target of reducing fatalities by 41 or more each year. This is based on our roadway types as well as the number of cars and trucks using our roadway system. This measure evaluates GDOT's efforts to reduce fatalities on Georgia's roads.

Strategic Objective

Reduce the number of fatalities by 41 each year.

Utah DOT: Cross-Department Collaboration

The Asset Management Steering Committee at the Utah Department of Transportation shows how the organizational structure of an agency can be less rigid, promoting inter-division coordination and improving results. Committee members meet bimonthly and are responsible for setting the direction of UDOT's asset management programs, including approval of safety, capacity, and preservation funding. Where before staff worked on related tasks independently within silos, this new structure has broken down some of the silos within the organization, reduced duplicative efforts, and aligned project spending with agency goals.

The committee is chaired by the DOT's deputy director; voting members report directly to the deputy and include all four region directors, the engineer for operations, and the directors of programming and planning. Division managers are nonvoting members.

Committee responsibilities also include review of the program, division performance targets, measures, and objectives and recommendation of funding levels to the state's Transportation Commission, which is responsible for approving funding. Performance data are used to prioritize projects across divisions.[37]

[36] Georgia Department of Transportation. Number of Fatalities Annually on Georgia's Roadways. Atlanta, GA. http://www.dot.ga.gov/BuildSmart/performance/Pages/Fatalities.aspx. Retrieved June 27, 2016.
[37] Transportation Research Board. (2014). Performance Management in Practice. *TR News No. 293*. http://onlinepubs.trb.org/onlinepubs/trnews/trnews293.pdf. Retrieved 13 June 2016.

STEP A.2.3	Identify and implement changes to organizational structure
	Maricopa Association of Governments: Addressing Resistance MAG wanted to take transportation performance management practices further by developing and using evaluative tools to prioritize investments in the region. Instead of developing these tools at the executive level or purchasing a tool from a vendor, the agency encouraged offices to create their own. While some staff were still resistant, this decentralized and semi-autonomous development built buy-in and did help to reduce resistance to this transportation performance management process. After some time using the evaluative tools, staff now hesitates to allocate funding without using them. Leadership is very supportive of the current situation because offices are working well together, with a common understanding that all projects will be subject to the prioritization tools. This has been a significant cultural shift at MAG and demonstrates how important it is to understand what concerns may arise and to have a plan to address those concerns.
Linkages to Other TPM Components	All (See TPM Framework)

A.3 TRAINING AND WORKFORCE CAPACITY

Employees must have the skills required to undertake transportation performance management activities. The agency should identify what skills should be included in training programs to ensure staff has the support needed to succeed in integrating transportation performance management processes into their activities.

1. Identify gaps in employee skillsets
2. Design, conduct, and refine training program
3. Build agency-wide support for TPM

> "When I come back to the office from a training or peer exchange, I'm a different person because I've learned something new. My immediate focus is on how to apply what I have learned to making our system even better. There is always room for improvement."
>
> - Camelia Ravanbakht, Hampton Roads TPO

STEP A.3.1	Identify gaps in employee skillsets
Description	Because transportation performance management processes are new, they will require skills that staff may not have. The agency should undertake an assessment of what skills currently exist among staff, and separately identify what skills will be needed for transportation performance management, based on agency goals as defined in the Strategic Direction (Component 01). These assessments will enable the agency to determine what skills will need to be developed. Once gaps in TPM skills and knowledge are identified, an agency must determine which gaps to close and how to close them. Prioritizing can be accomplished by first determining which skills are most instrumental in fulfilling the agency's strategic direction or mission. A transportation agency that places mobility above all other agency goals, for example, must not employ only traffic engineers. It will need to understand how to measure and communicate mobility within and outside the organization. To do this, employees will need skills in researching traffic data and patterns, in projecting demographic trends and user needs, and in analyzing and explaining concepts such as indexes for travel time, buffer time, and planning time. Some of these skills may exist within the organization, yet are underutilized. The tasks they support may need to be added to job descriptions to underscore their importance to staff. Some staff may possess these skills but do not regularly use them because their day-to-day activities do not require them. An organization may have to search for the right individuals with the right skills and knowledge to excel in TPM. When needed skills cannot be tapped from the existing workforce, the organization must search for them, often re-writing job descriptions as positions become vacant. Practitioners have identified the following skills, characteristics, and conditions as supportive of TPM: • Multimodal understanding • Multidisciplinary background • Creative • Consensus-oriented

STEP A.3.1	Identify gaps in employee skillsets

- Technologically savvy
- Data analysis, especially seeing the larger picture
- Translate data for legislators, executives
- Willing to continually learn
- Social media
- GIS
- Graphics/design
- Communication to variety of audiences including nontechnical
- Mix of engineers, planners, etc.
- Customer-service oriented
- Willing to learn by doing
- Meeting facilitation skills
- Ability to work across silos
- Data management, especially for quality

Whether altering the job responsibilities of existing staff or hiring staff from outside the organization to perform new tasks, the organization will need to communicate to the current workforce the rationale for this change. Individual change management requires that leaders of the organization understand how people successfully deal with change. Change agents and change leaders can assist individuals in making a successful transition either into a new TPM responsibility or in working with new staff assigned this responsibility. And whether teaching a new skill to a current staff member or hiring that skill from outside the organization, leadership must understand how to best to convey the "change" message to each individual. Not all individuals receive the message the same way. Some will be very supportive and eager to participate. Some will become defensive, and even plot to reduce the probability of success. Often the most difficult part of the change agent or change leader's assignment is to make changes "stick" in an individual's work, especially when that individual has a long history with the organization and the organization had not previously embraced TPM. As Prosci notes, "individual change management draws on disciplines like psychology and neuroscience to apply actionable frameworks to individual change."[38]

It is important that management provides the necessary support for skill development on an ongoing basis and if possible, for additional staff to fill roles as needed to support transportation performance management processes. This step should feed into subcomponent A.2 to help identify changes to the organizational structure discovered through the gap analysis.

Examples

NCDOT Assessment

As outlined in step A.2.1, the North Carolina DOT (NCDOT) underwent an agency-wide assessment by McKinsey and Company to identify ways to improve business processes. Along with the organizational issues already discussed, the assessment highlighted the DOT's failure to sufficiently recruit and retain talent critical to the operation of the agency. In addition,

[38] Prosci. (2016). Change Management Process. https://www.prosci.com/change-management/thought-leadership-library/change-management-process. Retrieved 13 June 2016.

STEP A.3.1	Identify gaps in employee skillsets

leadership was not effectively driving employee performance or developing top managers' skillsets.[39]

Many of these problems were a derivative of poor communication among management. NCDOT took this information and used it to make sweeping changes throughout the department that provided positive results. These changes enabled NCDOT to better address immediate needs, in addition to less immediate priorities, using data-driven methodology. This data-driven approach consolidated information so management could access vital information, in one place, to develop policies that were accessible to the entirety of the NCDOT management team.[40]

Figure A-10: North Carolina DOT Logo
Source: North Carolina DOT[41]

Ohio DOT:

Instead of assuming that all employees will stay in their current positions as new TPM processes are introduced, the Ohio DOT (ODOT) encouraged flexibility among its staff to move into positions that better match their skillset. This approach reduces the resources necessary to train staff for new processes by allowing those who already have the needed skills to fill the position. While this may cause additional organizational shifts that are difficult to accommodate amidst so much other change, it should be considered. Over the past decade, ODOT employees have moved to new functions and overall agency hiring requirements have been strengthened to ensure that new hires fit the needs of the agency as it furthers its TPM program.[42]

Linkages to Other TPM Components	All (See TPM Framework)

STEP A.3.2	Design, conduct, and refine training program
Description	Once needed skills are identified, a training program should be developed to close gaps in employee skillsets. This is critical to strengthening capabilities of the agency in achieving strategic goals. Training should be ongoing, and be improved each round using feedback from

[39] AASHTO. (2010). A CFO's Handbook on Performance Management. *Transportation Finance Briefing Papers*. http://www.transportation-finance.org/pdf/0211_performance_management_briefing_paper.pdf. Washington, DC. Retrieved 13 June 2016.
[40] North Carolina DOT. (2013). Development of a Performance Management System. http://www.fhwa.dot.gov/tpm/resources/docs/nc_casestudy.pdf. Retrieved 15 June 2016.
[41] North Carolina Department of Transportation. (2016). Logo. Raleigh, NC.
[42] National Cooperative Highway Research Program. (2009). TPM: Insight from Practitioners – Final Report. *NCHRP Report 08-62*. http://www.emeraldinsight.com/doi/pdfplus/10.1108/EJM-04-2011-0212. Retrieved 13 June 2016.

STEP A.3.2	Design, conduct, and refine training program
	employees. All training materials and feedback should be clearly documented to ensure that the effort is streamlined in future cycles and can provide the most skill improvement for the least cost to the agency. Additionally, training should be revised based on new developments and innovations in TPM, as well as lessons learned through agency experience. A proactive training program is hugely beneficial to reducing resistance to change among staff. Employees will easily become frustrated with their work if they lack the skills to do it; preventing this situation through proper and proactive training will produce better results. **Training can include:** • Seminars on transportation performance management • Attendance at conferences • Participation in peer exchanges Training can also be opportunistic. If the agency has a transportation performance management role that needs to be filled temporarily, use that opportunity to train the person who will fill that position. Once they return to their regular position, they will see things from a transportation performance management perspective, promoting adoption in a new area of the agency. Staff appreciates variety and will likely enjoy the change in routine for a short time.
Examples	**RiDOT Performance Management Training Course** The Rhode Island Department of Transportation (RiDOT) created a TPM training course for employees. Development of the course began after staff participated in a FHWA peer exchange on transportation performance management. The agency partnered with a professor at the University of Rhode Island Transportation Center to create the one-and-a-half day course that included a welcome given by the RiDOT Director, an overview of TPM in general and in particular in Rhode Island, the Federal perspective on TPM provided by a national FHWA representative, and a series of breakout sessions to engage staff in TPM activities. By including a broad array of representatives, it was made clear to staff that TPM is an important initiative that is endorsed nationally and at the highest level within the state organization. Activities related to alignment of goals, performance measure selection, and target setting. An exercise was included to develop employee skills relating to data, making clear that both statistics and interpretation are necessary to understand and use data to manage. The course also included a Moneyball analogy, referencing how transportation performance management in baseball led to major improvement for the Oakland Athletics despite a constrained budget. Putting TPM into a context staff could easily understand was a key part of the training course while activities were important to reinforce lessons and promote adoption of new practices, which has been successful as TPM practices continue to expand at RiDOT.
Linkages to Other TPM Components	All (See TPM Framework)

STEP A.3.3	Build agency-wide support for TPM

Description

While champions and early adopters within the agency help in promoting transportation performance management early on, eventually TPM needs to be institutionalized within the culture and day-to-day business processes. It is critical that transportation performance management takes hold throughout the organization and among all staff to ensure new processes actually have an impact on the way things are done, and on results.

In stating that "[c]ulture is to humans what water is to fish," Prosci explains that, "[t]he fish lives its entire life swimming through the water. The slightest variance in purity or temperature, and there would be a profound impact on the fish. We humans also live our lives moving through culture, which impacts us in thousands of tiny ways, and like the fish in water we are not always aware of what we are swimming through."[43]

> "Every time you have someone new come into the organization you have to convince them of the value of TPM."
>
> - Daniela Bremmer, Washington State DOT

Prosci sequences organizational change management into three phases, each phase with separate actionable steps, as listed below:[44]

Phase I – Prepare for Change

- Define your change management strategy
- Prepare your change management team
- Develop your sponsorship model

Phase II – Manage Change

- Develop change management plans
- Take action and implement plans

Phase III – Reinforce Change

- Collect and analyze feedback
- Diagnose gaps and manage resistance
- Implement corrective actions and celebrate success

The American Association of State Highway and Transportation Officials' (AASHTO) work has recognized that agencies can face challenges in building such support; these and some possible solutions are listed in the table below:[45]

[43] Prosci. (2016). Culture and Change Management: The Water we Swim In. http://blog.prosci.com/blog/culture-and-change-management-the-water-we-swim-in. Retrieved 13 June 2016.
[44] Prosci. (2016). Change Management Process. https://www.prosci.com/change-management/thought-leadership-library/change-management-process. Retrieved 13 June 2016.
[45] AASHTO. (2010). A CFO's Handbook on Performance Management. *Transportation Finance Briefing Papers*. http://www.transportation-finance.org/pdf/0211_performance_management_briefing_paper.pdf. Washington, DC. Retrieved 13 June 2016.

STEP A.3.3	Build agency-wide support for TPM

Table A-4: Challenges and Solutions in Implementing TPM

Source: AASHTO[46]

Challenge	Solution
Where staff is unionized, changes to the review process must be negotiated into a new labor agreement.	Plan for negotiation and ensure union leaders and rank and file members are included in process from the beginning.
Risk of creating a penalty-based performance-based employee evaluation system.	Ensure good communication throughout the process. Create advisory committee of staff when developing evaluations to gain credibility and buy-in, and adapt noteworthy practices from peer agencies. See step A.3.2.
With limited budgets, there may be no funding for bonuses that staff formerly received for exceptional performance.	Develop other creative incentives, including programs that provide an extra day of administrative leave or a premium parking space, or division level events such as pizza parties and barbeques.

Examples

Washington State DOT: Coloring Contest

WSDOT held a coloring contest in conjunction with take your daughter/son to work day. Employees' children could draw a picture that represented the agency and a group within the agency selected a winning drawing to be featured on the cover of its quarterly performance reporting publication, The Gray Notebook. Drawings considered honorable mentions were featured inside the report along with the winning artist and their parent. Staff and even the Secretary of Transportation were very engaged and excited about the contest and, while seemingly small, it brought people together with a feeling of community. This is an important "soft" aspect of transportation performance management; good morale and a feeling of "we're all in this together" are critical elements of a successful transportation performance management practice. The contest also helped to highlight The Gray Notebook among employees, which reinforced the agency's emphasis on TPM.[47]

> "TPM is built on a foundation of little things. Over time, TPM has become part of what we do, who we are, our culture."
>
> - Daniela Bremmer, Washington State DOT

Caltrans: Goal Teams

The California Department of Transportation (Caltrans) is involving different staff in developing measures, strategies, and data sources to promote culture change within the organization. Leadership has put together goal teams that are co-led by district directors and program-level

[46] AASHTO. (2010). A CFO's Handbook on Performance Management. *Transportation Finance Briefing Papers*. http://www.transportation-finance.org/pdf/0211_performance_management_briefing_paper.pdf. Washington, DC. Retrieved 13 June 2016.
[47] Washington State Department of Transportation. (2015). *The Gray Notebook, Issue 58*. http://wsdot.wa.gov/publications/fulltext/graynotebook/Jun15.pdf. Retrieved 13 June 2016.

STEP A.3.3	Build agency-wide support for TPM

staff. Some teams have external partners, and executive involvement varies considerably across the teams; leadership has provided the teams with a lot of autonomy. By decentralizing these particular aspects of TPM, Caltrans leadership has sought to promote TPM throughout various parts of the agency, many of which would not have been closely involved with selecting measures or evaluating data sources. This is an innovative way to help employees embrace performance measures and management. Because of relative success in developing measures, the agency has recommended continued use of goal teams in the future.

TxDOT: Peer Evaluations

The Strategic Planning Office at the Texas Department of Transportation (TxDOT) sought to spread TPM practices and improve agency results by initiating a peer evaluation program. District staff scores other districts on pavement condition using a consistent set of criteria. Through this initiative, district staff essentially participates in mini peer exchanges as they try to evaluate how other districts conduct business. By understanding how their practices impact performance, the evaluating staff can bring lessons back to their own district to improve results.

Utah Transit Authority (UTA): Lean Team

Budget constraints from the recession coupled with major expansion of UTA light rail, commuter rail, and streetcar service led UTA to adopt Lean principles and practices in 2012 to preserve transit service through operational efficiencies. Without these new practices, frequency and hours of service would have been reduced. As a result, service has been maintained and even increased in 2014 and 2015.

The Lean Team is a group of staff willing to go above and beyond to support transportation performance management that will improve operational efficiencies. Members include managers and supervisors from Operations, Maintenance, and Maintenance of Way and analysts, planners, and staff from other departments such as Customer Service.

The Team has advanced TPM at UTA by:

- Developing and delivering training modules to explain Lean concepts and tools to all Operations supervisors and managers using UTA-specific examples
- Presenting Lean project case studies to all managers at UTA
- Facilitating a variety of continuous improvement projects at the request of Operations and other departments

Key results include:

- Installing transmission software on all buses 2007 and newer to regulate acceleration and improve miles per gallon
- Placing operator restroom trailers at key end-of-line locations to increase operator comfort and eliminate costly mid-route layovers for restroom breaks
- Improving miles per service interruption by placing mechanics at key end-of-line locations and keeping buses in service until they reach the end of line if possible
- Major cleaning and reorganizing of maintenance shops, leading to reductions in duplicate part orders and wasted time looking for parts (20% reduction in parts cost per mile)

STEP A.3.3	Build agency-wide support for TPM

- Improved ratio of paid time to platform time and decreased number of split shifts by 47% through restructured employee shifts
- Supplier analysis to determine most cost-effective material suppliers, saving $19K per engine
- New web-based analytics platform combining multiple data sources into one unified report

While some time is provided during work hours for Lean Team training, much of the learning group members complete occurs on their own time; however, these individuals receive a lot of attention from leadership and other staff. Their role in helping other divisions within the agency improve their business processes is critical in promoting culture change at UTA. Lean Champions are ambassadors, spreading TPM from parts of the agency where it is successful and mature to others where it is just getting started. Often Lean Champions are promoted before other staff, not because it is required, but because they have gained an understanding of TPM and of various parts of the agency. The program has successfully expanded TPM practices while training staff in needed skills.

Victoria Transport Policy Institute: Developing Support for Innovation

In "Change Management: Developing Support for Innovation," the Victoria Transport Policy Institute notes:

> *Change Management* refers to activities that support organizational innovation and reform….It recognizes that organizations often have inertia that must be overcome to create more efficient, responsive and resilient organizations. Special effort is often required to overcome the normal inertia of people and organizations to new approaches and practices, even if they are significantly better overall in the long run. This inertia reflects *path dependency*, the tendency of existing systems to perpetuate themselves…due to the high costs of changing equipment and people's habits.

The Institute recommends these noteworthy practices for shifting to Transportation Demand Management (TDM):

- Work to create a climate that values innovation and supports appropriate risk taking.
- Establish a vision with clear goals, objectives and performance indicators (Transport Planning). This vision provides a reference for describing to stakeholders why change must occur and evaluating progress. Establish a long-range plan, which identifies how individual policy and program reforms support overall goals.
- Develop a team to support change. No single person can implement change alone.
- Communicate a sense of urgency. Most stakeholders will consider change uncomfortable and risky. Without a sense of urgency people tend to avoid change. To motivate change it is necessary to make existing conditions seem more dangerous than the proposed changes. Failure should be defined as continuing with the status quo.
- Educate stakeholders about new policies and programs. Opposition often reflects misunderstandings.
- Don't be deterred by setbacks. An innovation often fails to be accepted the first time it is introduced, but succeeds with persistence. Do not abandon TDM if a proposal is rejected the first time it is introduced. Instead, continue to educate stakeholders of

STEP A.3.3	Build agency-wide support for TPM
	its value, address objections, and try again. • Accept risks. Change requires risk. Accept the change [sic] that a plan will not turn out as expected. Learn from the experience and try again. • Emphasize (but don't exaggerate) benefits. TDM tends to provide multiple benefits, so let stakeholders know about all of them. • Emphasize different types of benefits to different interest groups. For example, to transportation professionals and businesses, emphasize the economic justifications for TDM, since it is often a cost effective way to address parking and traffic problems. To community groups, emphasize benefits to neighborhood environmental quality, and benefits to non-drivers. To designers and planners, emphasize increased flexibility and support for strategic development objectives. • Work with stakeholders to identify and address points of opposition. • Look for small victories. Small victories are the fuel that will keep your team energized for ongoing efforts. Find reasons to celebrate successes whenever you can. Use small victories to build team confidence and momentum. • Be willing to negotiate and compromise. For example, if there is opposition to priced parking on the grounds that this would impose an excessive financial burden on some lower-income people, offer a certain number of need-based discounts or exemptions.[48]
Linkages to Other TPM Components	All (See TPM Framework)

[48] Victoria Transport Policy Institute. (2016). Change Management: Developing Support for Innovation. http://www.vtpi.org/tdm/tdm114.htm. Retrieved 13 June 2016.

A.4 MANAGEMENT PROCESS INTEGRATION

By linking employee actions to the agency's goals and objectives, the organization will be more highly focused on performance results as the driver of agency activities, integrating transportation performance management into day-to-day tasks.

1. Incorporate performance discussions into regular management meetings
2. Link employee actions to strategic direction
3. Regularly set expectations for employees through measures and targets

> "An organization that does not adequately communicate its strategic goals to employees on the front lines has failed to complete its mission. A strong performance management environment allows employees at every level to make choices, take actions, and measure results in accordance with defined strategic goals."
>
> - Carlos Braceras, Executive Director, Utah DOT

STEP A.4.1	Incorporate performance discussions into regular management meetings
Description	Throughout the steps taken to implement TPM at an agency, it should be clearly communicated that performance information is not intended as a way to punish employees; rather this information provides insight into why results are what they are and therefore how to adjust strategies to improve. This information is especially important to highlight in regular management meetings when TPM is just beginning to take shape at an agency. As TPM matures, performance discussions should become an integral part of management meetings and managers should use performance language to frame discussions of how to improve. Start by using such language with executives, and it will cascade through the agency. Typically the "big picture" vision is provided by the agency's CEO or another top-level executive while a more pragmatic operational focus on results, challenges, and specific measures is needed to turn the vision into a management framework and action plan. This happens at the division head level because they understand the unique needs and attributes of their area.[49] Changing how performance is communicated to various levels of staff is important (see subcomponent 6.1 Internal Reporting and Communication) to make performance information meaningful. Front line workers need to know what is happening with their assets on a particular day and how that impacted customers. Avoid monthly trends and other high level information that does not resonate.
Examples	**Maryland Transportation Authority** The MDTA is a modal administration within the Maryland Department of Transportation and is responsible for eight tolling facilities across the state. It also finances new revenue-producing transportation projects. All of its operations and projects are funded through toll revenue paid by users. The authority created a transportation performance management team with one member from each of the 10 Divisions, with members rotating every 18 months. The team was created to establish more regular internal transportation performance management

[49] National Cooperative Highway Research Program. (2010). Transportation Performance Management: Insight from Practitioners. *NCHRP Report 660*. Washington, DC. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf. Retrieved 13 June 2016.

STEP A.4.1	Incorporate performance discussions into regular management meetings

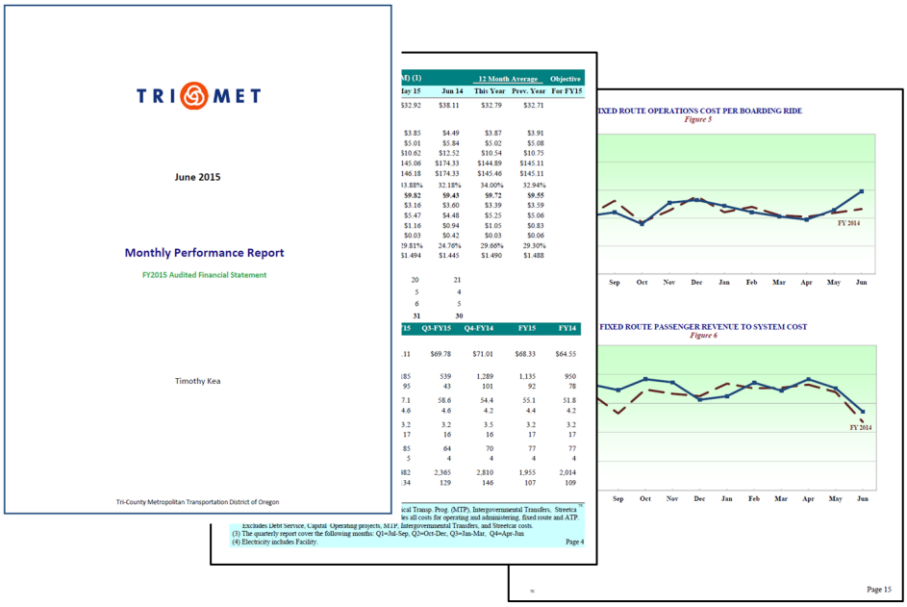
discussions; the team meets monthly to monitor performance measures and targets included in MDTA's Business Plan. One of the team's responsibilities was to change the employee annual evaluation process to link personnel reviews to performance. Since 2008, the team has been reporting during quarterly meetings of MDTA's Management Committee. By establishing a standalone group that could focus on transportation performance management, the authority was able to integrate transportation performance management in a step-wise manner. Once the team was well established, it took on a more important role by incorporating TPM discussions into regular MDTA meetings.[50]

TriMet: Portland, OR

TriMet, the transit agency for the Portland area, has embraced the use of performance data in management meetings. Managers hold monthly meetings with their staff to go over performance results and discuss why trends are occurring and what can be done to improve. The meetings are conversational rather than confrontational, which makes performance data and transportation performance management more attractive to employees who may be wary of it. Monthly meetings have made an impact within the organization and have enabled managers to zero in on areas where adjustments will make the most impact. Rather than being used to punish individual operators, performance data are being used to determine if routes as a whole need to be restructured because all operators are demonstrating low performance. If only individual operators are struggling, managers approach them seeking to provide support or training to help the operator improve.

Figure A-11: TriMet Performance Report

Source: Monthly Performance Report[51]



[50] AASHTO. (2010). A CFO's Handbook on Performance Management. *Transportation Finance Briefing Papers*. http://www.transportation-finance.org/pdf/0211_performance_management_briefing_paper.pdf. Washington, DC. Retrieved 13 June 2016.

[51] Tri-County Metropolitan Transportation District of Oregon. (June 2015). Monthly Performance Report. Portland, OR. https://trimet.org/pdfs/publications/performance-statistics/2015-06.pdf

STEP A.4.1	Incorporate performance discussions into regular management meetings
Linkages to Other TPM Components	Component 01: Strategic Direction (See TPM Framework)

STEP A.4.2	Link employee actions to strategic direction
Description	To drive progress toward strategic goals, employees must first know what the agency's goals are, and then be able to link their daily activities to attaining targets and meeting goals and objectives. The goals and objectives contained within the Strategic Direction (Component 01) are the driving force behind all agency activities, from CEO to the front line. Employees must also maintain focus on targets (Component 02) to identify how their work can be adjusted to push progress toward attainment. By maintaining focus on the goals, objectives, and targets, the agency will continue to move in the desired direction and this will be reflected in performance results. "All employees need to understand how what they do affects the traveling public. It's not just filling a pothole, it's creating a safer environment, a better quality and reliable drive for the traveling public." - Stacey Strittmatter, Texas DOT Create a strong link to the strategic direction in internal communications to build internal buy-in and shift the organization's culture toward transportation performance management. Remind employees of their involvement in developing goals to ensure that goals are not seen only as the leadership's goals. Make it real for front line staff: how does repainting a bridge impact system users? By improving bridge condition, the employee is ensuring a safer trip for someone getting to a doctor's appointment, or children being driven to school. Employees should understand how their activities impact others. Connect short-term actions to long-term results. Because of requirements initiated by MAP-21, the agency is already undertaking transportation performance management activities such as the Transportation Asset Management Plan. These serve as the foundation of TPM and further integration of transportation performance management processes can build from them.[52] A formal linkage should only be created after employees have been educated about goals, objectives, measures and targets and they have been well established within the agency.[53]
Examples	**WMATA Business Plans** The Washington Metropolitan Area Transit Authority (WMATA) created Business Plans to clearly link day-to-day activities of employees to the agency's strategic direction. Their function is outlined in Figure A-12, below:

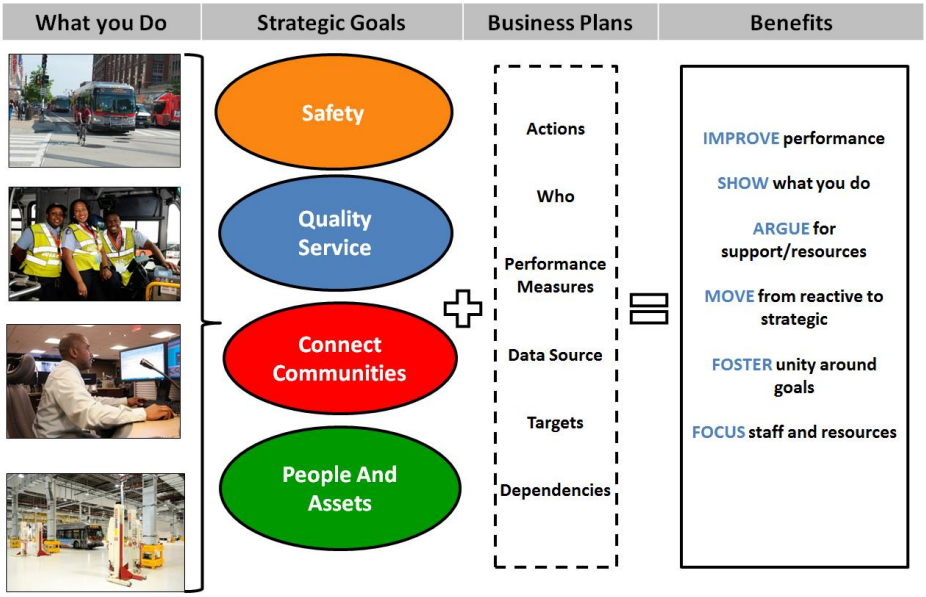
[52] National Cooperative Highway Research Program. (2015). The Role of Planning in a 21st Century State Department of Transportation—Supporting Strategic Decisionmaking. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_798.pdf. *NCHRP Report 798*. Washington D.C. Retrieved 13 June 2016.

[53] AASHTO. (2010). A CFO's Handbook on Performance Management. *Transportation Finance Briefing Papers*. http://www.transportation-finance.org/pdf/0211_performance_management_briefing_paper.pdf. Washington, DC. Retrieved 13 June 2016.

STEP A.4.2	Link employee actions to strategic direction

Figure A-12: WMATA Business Plans

Source: Link Day-to-Day Work to Strategic Goals Presentation[54]



Page one of the plans describes the responsibilities of the work group, provides an overview of activities undertaken by employees in that work group, and lists accomplishments of the group from the previous calendar year.

The following pages list performance measures by agency goal. For each measure, the plan includes:

Table A-5: Information Included within Business Plans

Source: Federal Highway Administration

Information	Example
Performance target	Five % below Previous CY
Key actions for employees to take	Pilot test DAS lights, due to the high number of rear-end collisions where buses are being hit. Assess value of lights in reduction of such collisions.
The responsible office	Safety
Timeframe	Ongoing
Action owner	Employee name
Dependencies within agency	OMPS

Linkages to Other TPM Components	Component 01: Strategic Direction	(See TPM Framework)

[54] Washington Metropolitan Area Transit Authority. (2013). Link Day-to-Day Work to Strategic Goals Presentation. Washington, DC.

STEP A.4.3	Regularly set expectations for employees through measures and targets
Description	Once employees understand their roles and responsibilities (subcomponent A.2) and the expectation that daily activities should relate to strategic goals and targets (step A.3.2), managers should begin to hold them accountable by implementing performance-based employee evaluations. This will promote a sense of shared responsibility among staff.[55] Running a pilot can be an effective way to establish such evaluations; starting with one division, or with senior managers will allow management to adjust and improve the evaluations before expanding to the agency as a whole. However, there is some disagreement about linking employee evaluations to performance. It is difficult to do so for accounting staff and others who do not have roles directly related to transportation outputs and outcomes. It also can be seen as a punishment tool rather than a motivator. It may be better to implement such evaluations when the TPM program is more established; this will reduce initial resistance among staff and enable a smoother integration. Providing recognition or rewards to employees who go above and beyond or demonstrate commitment to TPM practices can show that performance data will not be used to punish. By highlighting employees who are supportive, TPM will spread more quickly through the organization. Even more effective is external recognition; leadership and managers should put employee names forward when possible. **Alternatives to performance-based employee evaluations include:** • Publicize comparative data across work groups or employees. This may be more acceptable to employees than performance-based evaluations, but can also be difficult to implement because of data comparison issues.[56] • Identify program directors as key performance indicator (KPI) owners, but keep this information unrecorded or at least unreported. This may instill ownership among program directors without the threat of punishment.
Examples	**Maryland State Highway Administration (SHA)** SHA, a modal administration within the Maryland Department of Transportation, is piloting a program to link managers' performance reviews to office/district business plans as well as individual performance targets. Office and district plans reflect the SHA Business Plan, which reflects MDOT priorities. The administration has changed its personnel assessment forms to incorporate transportation performance management; the assessment now has two parts: Leadership competencies (40 percent) and an annually updated Performance Plan (60 percent). Staff down to the mid-management level has reviews tied to performance data that focus on output measures. The reviews are designed to increase the prominence of the office/district business plans across the agency so every employee can see how performance measures are used as a management tool and identify how their work supports the goals of the organization.[57]

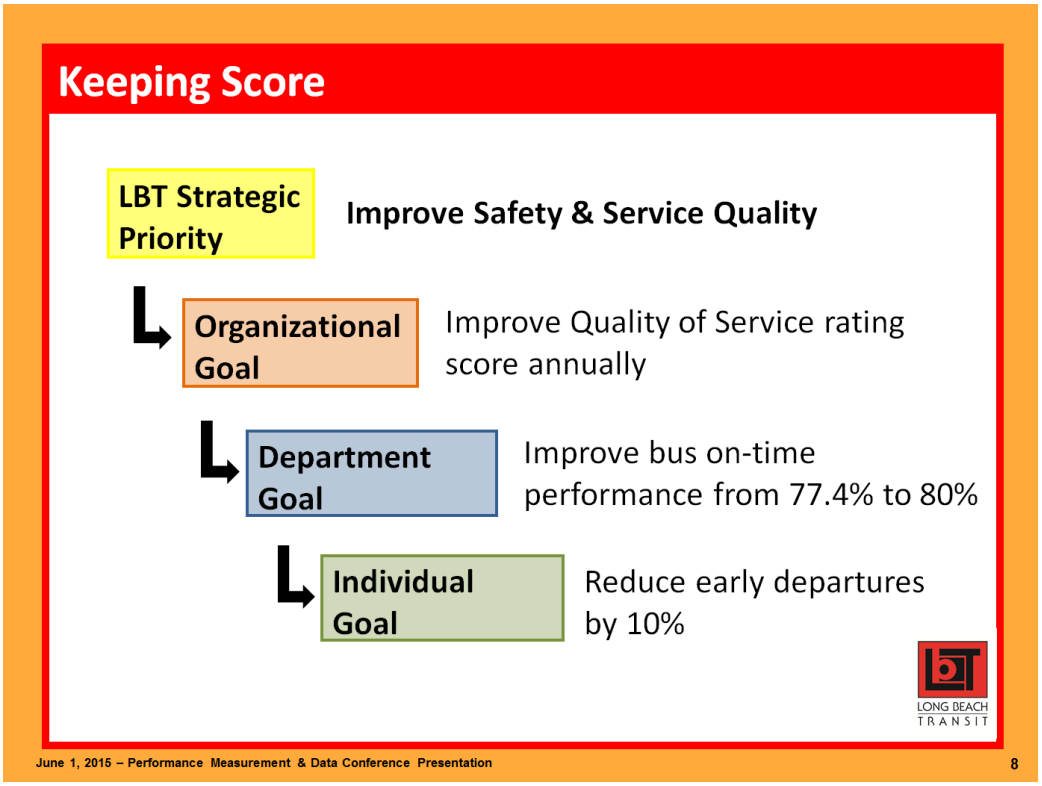
[55] National Cooperative Highway Research Program. (2010). Transportation Performance Management: Insight from Practitioners. *NCHRP Report 660*. Washington, DC. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf. Retrieved 13 June 2016.
[56] National Cooperative Highway Research Program. (2010). Transportation Performance Management: Insight from Practitioners. *NCHRP Report 660*. Washington, DC. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf. Retrieved 13 June 2016.
[57] AASHTO. (2010). A CFO's Handbook on Performance Management. *Transportation Finance Briefing Papers*. http://www.transportation-finance.org/pdf/0211_performance_management_briefing_paper.pdf. Washington, DC. Retrieved 13 June 2016.

STEP A.4.3	Regularly set expectations for employees through measures and targets

Long Beach Transit: Setting Expectations with Measures and Targets

Long Beach Transit (LBT) service includes bus and ferry routes covering 13 cities south of Los Angeles, CA. Annually, the agency sees 29 million boardings. As a way to more effectively use resources, LBT leadership has engaged with performance data to convert it into information that is usable for improving results. The agency's Scoreboard helps staff analyze raw data to make informed decisions to drive performance. Combined with strategic goals, the Scoreboard serves as a roadmap for improving results on the organizational, department and individual level as seen in the image below. LBT uses performance measures and targets such as "reduce early departures by 10%" that link back to strategic goals through department and organizational goals, making clear expectations of individuals within the agency.

Figure A-13: Long Beach Transit Linkage Between Agency, Department, and Individual Goals
Source: Keeping Score for the Game our Customers Care About[58]



This commitment to linking organizational mission to the day-to-day activities of staff is clear even before employees are hired. Job postings state how the responsibilities of a particular position contribute to the agency's vision and mission. For example, a Part-Time Data Collector contributes to the agency mission to "provide transit services that enhance and improve the quality of life for residents" by collecting data that is used to plan new routes and schedules

[58] McDonald, K. (2015). *Keeping Score for the Game our Customers Care About*. Presentation [PDF}. Retrieved from http://onlinepubs.trb.org/onlinepubs/conferences/2015/performancemeasurement/McDonald-1PS.pdf

STEP A.4.3	Regularly set expectations for employees through measures and targets
	that better align with residents' needs.[59] By stating this information in the first line of a job posting, the agency is ensuring that potential employees understand that their role will be linked to agency goals. When LBT's long-time CEO retired, the advertisement for the position included the following under duties and responsibilities of the position: "Translates and communicates the organization's vision into concrete plans and measurable goals for staff."[60]
Linkages to Other TPM Components	Component 01: Strategic Direction Component 02: Target Setting Component C: Data Management Component D: Data Usability and Analysis (See TPM Framework)

[59] Data Collector (Part Time). Long Beach Transit Career Opportunities. http://lbtransit.jobinfo.com/public/description.php?jid=9902044
[60] Long Beach Public Transportation Company. President and CEO. http://www.lbtransit.com/jobs/pdf/LBT-CEO-Brochure.pdf

RESOURCES

Resource	Year	Link
TPM Toolbox	2016	www.tpmtools.org
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
NCHRP Report 798: The Role of Planning in a 21st Century State Department of Transportation—Supporting Strategic Decisionmaking	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_798.pdf
NCHRP Report 660: Transportation Performance Management: Insight from Practitioners	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf
A CFO's Handbook on Performance Management	2010	http://www.transportation-finance.org/pdf/0211_performance_management_briefing_paper.pdf

ACTION PLAN

1. Of the TPM subcomponents discussed in this chapter, which one would you like to work on?

❑ Leadership Team Support ❑ Roles and Responsibilities ❑ Training and Workforce Capacity ❑ Management Process Integration

2. What aspect of the TPM process listed above do you want to change?

3. What "steps" discussed in this chapter do you think could help you address the challenge noted above?

Leadership Team Support

- ❑ Evaluate how new agency processes have been implemented previously
- ❑ Develop TPM pitch
- ❑ Clarify role of senior and executive management

Roles and Responsibilities

- ❑ Assess current organizational structure
- ❑ Define and document TPM roles and responsibilities
- ❑ Identify and implement changes to organizational structure

Training and Workforce Capacity

- ❑ Identify gaps in employee skillsets
- ❑ Design, conduct, and refine training program
- ❑ Build agency-wide support for TPM

Management Process Integration

- ❑ Incorporate performance discussions into regular management meetings
- ❑ Link employee actions to strategic direction
- ❑ Regularly set expectations for employees through measures and targets

4. To implement the "step" identified above, what actions are necessary, who will lead the effort and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success?

6. Who is someone (internal and/or external) I will collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

TABLE INDEX

U.S. Department of Transportation
Federal Highway Administration

COMPONENT B

EXTERNAL COLLABORATION & COORDINATION

This chapter provides assistance to transportation agencies with the "External Collaboration and Coordination" component of Transportation Performance Management (TPM). It discusses where the component occurs within the TPM Framework, describes how it interrelates with the other nine components, presents definitions for associated terminology, provides links to regulatory resources, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for external collaboration and coordination may differ from what is included in this chapter.

B External Collaboration & Coordination

B.1 Planning & Programming
B.2 Monitoring & Reporting

External Collaboration and Coordination refers to established processes to collaborate and coordinate with agency partners and stakeholders on planning/visioning, target setting, programming, data sharing, and reporting. External collaboration allows agencies to leverage partner resources and capabilities, as well as increase understanding of how activities impact and are impacted by external factors.

INTRODUCTION

The implementation steps in this component will assist an agency in establishing processes to collaborate and coordinate with partner agencies and the public to establish goals, objectives, and performance measures (Component 01); set targets (Component 02); develop planning documents (Component 03); and program projects (Component 04). This chapter also addresses collaboration for data sharing (Components C and D), monitoring (Component 05) and reporting (Component 06).

As defined in Table B-2, collaboration and coordination are different, but related:

- **Collaboration:** Efforts to organize people or groups to enable them to work together effectively.
- **Coordination:** To work with another person or group in order to accomplish a task.

While these two terms are closely related, they are defined separately to ensure clarity. Collaboration refers to how people or groups across stakeholders are engaged, such as through working groups. Coordination is the work itself, but can also refer to activities seeking to define and develop collaborative efforts.

Collaboration with external partners and stakeholders offers opportunities. A transportation agency may be able to coordinate data collection or reporting to more efficiently use resources. There may be opportunities to track multiple goals with a single measure or to create new measures that will be used by multiple agencies to track a goal that was previously unquantifiable.

Because transportation agency results are impacted by influencing factors such as economic growth, and in turn affect areas such as public and environmental health, coordination with stakeholders that focus in such areas can provide transportation agency staff greater understanding of these relationships. Understanding these complex interactions will enable agencies to set more accurate targets, better reflect regional priorities in planning documents, and more strategically program projects to achieve desired outcomes. For more information, refer to Step 2.1.3, Identify influencing factors and assess risk (internal and external) in Component 02, Target Setting.

Collaboration with the public through scenario planning can also assist agencies in setting relevant goals and ensuring resource allocation will make progress toward those goals. Understanding what the public desires will be important as the agency reports performance results so that communication is tailored and provides the proper context for reports to be understood by the general public. Lawmakers are an additional external group who should be consulted to ensure that funding levels and performance outcomes are aligned. Elected officials should have a realistic understanding of what is achievable within current and projected funding environments. As with the public, understanding this group's desires and expectations will assist in later reporting.

External collaboration and coordination will be most successful when agency staff:

- Provide leadership to reward collaboration and set expectations for coordination
- Continually look for opportunities to collaborate and improve coordination
- Build on existing collaboration practices

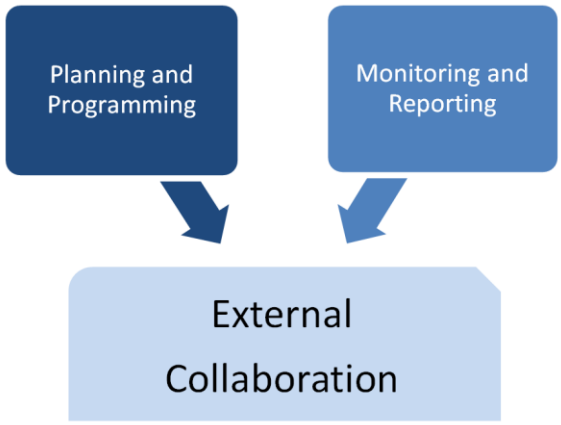
Most importantly, agencies should seek to build on existing collaboration and coordination. Many requirements concerning external coordination and collaboration exist and agencies have been undertaking these activities; staff should look for ways to further leverage these existing collaboration efforts. For example, regulations require the use of a documented public participation process through development of the long-range transportation plan. Because agencies are already fulfilling this requirement, additional engagement can easily build from the relationships established through this process.[1]

[1] 23 CFR § 450.210 (a)(1)(vii) and 316 (a)(1)(vii)

SUBCOMPONENTS AND IMPLEMENTATION STEPS

Figure B-1: Subcomponents for External Collaboration and Coordination

Source: Federal Highway Administration



The definition for External Collaboration and Coordination is: established processes to collaborate and coordinate with agency partners and stakeholders on planning/visioning, target setting, programming, data sharing, and reporting. External collaboration allows agencies to leverage partner resources and capabilities, as well as increase understanding of how activities impact and are impacted by external factors. The component is comprised of two subcomponents (Figure B-1):

- **Planning and Programming:** Coordinating and collaborating with external agency partners to establish goals, objectives, performance measures, and targets and to program projects to achieve established performance targets.
- **Monitoring and Reporting:** Coordinating and collaborating with external agency partners on performance monitoring and reporting.

Collaboration and coordination during planning and programming processes begins as the agency defines its strategic direction (Component 01) by establishing goals, objectives, and measures. These elements should be integrated across partner agencies and performance-based plans and the LRTP to form a cohesive regional strategic direction. Achieving performance targets that have been agreed upon through coordination among agencies will require fewer resources if programming decisions are also coordinated. Completing particular projects together can prevent duplicative effort.

Collaboration and coordination for monitoring and reporting processes produces benefits from data sharing among agencies. Consistent measures across agencies reduce the collective costs of monitoring and reporting. Likewise, agencies can coordinate reporting efforts by releasing combined reports, such as Washington State DOT's Corridor Capacity Report that includes both transit and road network performance data to provide a holistic perspective on corridor mobility.[2] This will align data collection timelines and more fully link partner agency processes that will produce further efficiencies.

The implementation steps in Table B-1 will assist an agency in collaborating more effectively with external partners and stakeholders. Additional information concerning external collaboration and coordination can be found throughout the other Components of this guidebook, including:

- Component 01: Strategic Direction
- Component 02: Target Setting
- Component 03: Performance-Based Planning
- Component 04: Performance-Based Programming
- Component 05: Monitoring and Adjustment
- Component 06: Reporting and Communication

[2] 2015 Corridor Capacity Report. June 14, 2016. http://www.wsdot.wa.gov/Accountability/Congestion/2015.htm

Table B-1: External Collaboration and Coordination Implementation Steps

Source: Federal Highway Administration

Planning and Programming	Monitoring and Reporting
1. Engage with external stakeholders to establish goals, objectives, and measures	1. Implement data sharing protocols
2. Collaboratively establish targets	2. Review and discuss content of reports to ensure consistent messaging
3. Develop and implement strategies in a collaborative manner	3. Formalize process for monitoring and reporting

CLARIFYING TERMINOLOGY

Table B-2 presents definitions for some of the terms used in this guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table B-2: External Collaboration and Coordination: Defining Common TPM Terminology

Source: Federal Highway Administration

Common Terms	Definition	Example
Collaboration	Efforts to organize people or groups to enable them to work together effectively.	Establishment of a target setting working group to set common targets in a bi-state urbanized area.
Coordination	To work with another person or group in order to accomplish a task.	Undertaking work to set common targets.
Customer	Users of an agency's services.	For a transit agency, riders of buses, light rail, and other transit modes. For a DOT, drivers, walkers, bicyclists, and others.
Goal	A broad statement of a desired end condition or outcome; a unique piece of the agency's vision.	A safe transportation system.
Monitoring	The identification and diagnosis of performance systems and programs.	Freeway and Arterial System of Transportation (FAST), a real-time traffic condition dashboard that enables detailed analysis on request.
Objective	A specific, measurable statement that supports achievement of a goal.	Reduce the number of motor vehicle fatalities.
Outcome	Results or impacts of a particular activity, most of interest to system users. Focus of subcomponent 5.1 System Level Monitoring and Adjustment.	Transit travel time reliability, fatality rate, percent of assets within useful life.
Output	Quantity of activity delivered through a project or program. Focus of subcomponent 5.2 Program/Project Level Monitoring and Adjustment.	Miles of pavement repaved, miles of new guardrail put into place, the number of bridges rehabilitated, the number of new buses purchased.

Common Terms	Definition	Example
Partner	An organization involved in administering transportation programs and policies, whether directly or indirectly. Involvement includes, but is not limited to, target setting, planning, programming, monitoring, and reporting.	Transportation agencies, emergency personnel, chambers of commerce, local government.
Performance Measure	Performance measures are based on a metric that is used to track progress toward goals, objectives, and achievement of established targets. They should be manageable, sustainable, and based on collaboration with partners. Measures provide an effective basis for evaluating strategies for performance improvement.	Transit passenger trips per revenue hour.
Reporting	Summary documentation of performance trends for either internal or external audiences.	WSDOT Gray Notebook.
Stakeholder	Person or group affected by, or who believe themselves to be affected by, a transportation agency's activities. This includes, but is not limited to, customers and partners.	In developing the long-range transportation plan, agencies must engage the general public and representatives of system users such as bicyclists, freight shippers, and public transportation riders.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.

RELATIONSHIP TO TPM COMPONENTS

The ten TPM components are interconnected and often interdependent. Subcomponents for External Collaboration and Coordination are closely intertwined with other components: subcomponent B.1 relates to Component 01: Strategic Direction, Component 02: Target Setting, Component 03: Performance-Based Planning, and Component 04: Performance-Based Programming. Subcomponent B.2 relates to Component 05: Monitoring and Adjustment and Component 06: Reporting and Communication. Table B-3 highlights these relationships.

Table B-3: External Collaboration and Coordination Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to External Collaboration
01. Strategic Direction	The establishment of an agency's focus through well-defined goals/objectives and a set of aligned performance measures.	Goals should be supportive across agencies to ensure agency activities are aligned while shared measures maximize efficiency in data collection and monitoring efforts.
02. Target Setting	The use of baseline data, information on possible strategies, resource constraints and forecasting tools to collaboratively set targets.	Collaboration in target setting ensures targets reflect influencing factors as understood by partners.

Component	Summary Definition	Relationship to External Collaboration
03. Performance-Based Planning	Use of a strategic direction to drive development and documentation of agency strategies and priorities in the long-range transportation plan and other plans.	With coordinated goals and measures across partners and reflective of public priorities, planning documents will also be aligned to promote synergistic progress toward goals.
04. Performance-Based Programming	Allocation of resources to projects to achieve strategic goals, objectives and performance targets. Clear linkages established between investments made and their expected performance outputs and outcomes.	With agencies allocating resources in a coordinated manner, strategic goals are more likely to be achieved. Regional priorities reflected in strategic goals will be reflected in activities undertaken by partner agencies.
05. Monitoring and Adjustment	Processes to monitor and assess actions taken and outcomes achieved. Establishes a feedback loop to adjust programming, planning, and benchmarking/target setting decisions. Provides key insight into the efficacy of investments.	Shared monitoring can significantly improve TPM efficiency by eliminating the need for duplicative data collection and management systems across agencies. Coordinated systems support cross-agency discussions regarding strategy adjustments.
06. Reporting and Communication	Products, techniques, and processes to communicate performance information to different audiences for maximum impact.	Partners can increase public understanding of TPM results and processes by maintaining consistent messaging, as well as reduce resources required for reporting.
A. TPM Organization and Culture	Institutionalization of a TPM culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support TPM.	As external collaboration becomes part of the agency's culture, future coordination activities will become streamlined. A supportive culture in turn promotes more robust collaboration in subsequent iterations of TPM processes.
C. Data Management	Established processes to ensure data quality and accessibility, and to maximize efficiency of data acquisition and integration for transportation performance management.	Data collection efficiencies gained through external collaboration can reduce resource use or enable expanded measurement capabilities.
D. Data Usability and Analysis	Existence of useful and valuable data sets and analysis capabilities, provided in usable, convenient forms to support TPM.	Coordination for data analysis is a primary area of focus for external collaboration, especially during target setting and monitoring.

REGULATORY RESOURCES

This Guidebook is intended only to assist agencies with implementing transportation performance management in a general sense and not to provide guidance on compliance and fulfillment of Federal regulations. However, it is important to consider legislative requirements and regulations when using the Guidebook. In many cases, use of this Guidebook will bring an agency in alignment with Federal requirements; however, the following sources should be considered the authority on such requirements:

Federal Highway Administration

- Transportation Performance Management: http://www.fhwa.dot.gov/tpm/links_fhwa.cfm
- Fact Sheets on Fixing America's Surface Transportation (FAST) Act: https://www.fhwa.dot.gov/fastact/factsheets/
- Fact Sheets on Moving Ahead for Progress in the 21st Century (MAP-21): https://www.fhwa.dot.gov/map21/factsheets/
- Resources on MAP-21 Rulemaking: https://www.fhwa.dot.gov/tpm/rule.cfm

Federal Transit Administration

- Fact Sheets on FAST Act: https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-fast-act
- Resources on MAP-21: https://www.transit.dot.gov/regulations-and-guidance/legislation/map-21/map-21-program-fact-sheets

IMPLEMENTATION STEPS

B.1 PLANNING AND PROGRAMMING

The steps in this subcomponent will assist an agency in collaboration with partners to establish a strategic direction and guide planning and programming processes. For this subcomponent, each implementation step is cross-referenced with other implementation steps from other subcomponents.

1. Engage with external stakeholders to establish goals, objectives, and measures
2. Collaboratively establish targets
3. Develop and implement strategies in a collaborative manner

> "Specifically, State DOTs, MPOs, RTPOs, and transit agencies need to align their goals, objectives, measures, and targets with one another. This does not mean that each agency must use the same goals, objectives, and measures… However, it is important that goals and objectives of various transportation agencies working in the same areas are supportive of each other."
>
> Source: FHWA, Performance Based Planning and Programming Guidebook

STEP B.1.1	Engage with external stakeholders to establish goals, objectives, and measures
Description	**Goals and Objectives** Before beginning the process of selecting goals, objectives, and measures, staff should have an understanding of how the transportation system is performing to frame the discussion about long-term transportation trends, needs, and desired future conditions. Collaboration with external agencies is a key way to obtain this understanding from a broad set of perspectives. Agencies should engage partners and stakeholders like State DOTs, MPOs, RTPOs, and transit agencies as well as local government, the business community, and economic development organizations. Examples of engagement with such partners and stakeholders can be found in FHWA's PlanWorks resource.[3] Discussions should include historical, current, and forecasted performance conditions. Discussions should also cover varying interests and needs for development of performance-based plans such as the Transportation Asset Management Plan (TAMP), Strategic Highway Safety Plan (SHSP), and Freight Plan in addition to development of long-range plans. SHSPs are an example of where effective collaboration and coordination among law enforcement, transportation engineers, and policy makers has produced results. Crash reporting by law enforcement provides the data necessary for transportation agencies to identify high crash areas. With this information, agencies can develop strategies to improve safety and reduce crashes. SHSPs establish goals, objectives, and strategies related to safety. Goals and objectives should be discussed with partner agencies to ensure activities undertaken by partners are supportive of each others' goals. "It took a full year working with local partners, consultants, stakeholders and the public, but we now have a collaborative performance framework for the region." - Monique de los Rios-Urban, Maricopa Association of Governments

[3] FHWA. PlanWorks, LRP-2: Approve Vision and Goals. https://fhwaapps.fhwa.dot.gov/planworks/DecisionGuide/Step/2

STEP B.1.1	Engage with external stakeholders to establish goals, objectives, and measures

The public and other stakeholders must also be engaged through the goal-setting process to ensure agency goals reflect regional priorities, particularly during long-range plan development. Stakeholder engagement is also an opportunity for the agency to clarify the linkage between core agency functions and broader societal concerns and discuss the relative priority of goals. Input from stakeholders should be used to refine goals and objectives so that they resonate outside of the agency.

> "The biggest barriers to collaborative performance-based planning and programming are organizational and institutional. Therefore, strong support from upper management can make a significant impact."
>
> Source: NCHRP 8-36 (104), Performance-Based Planning and Programming Pilots

In addition to making the goal-setting process more relevant, external engagement is also Federally required as part of the transportation plan development process.[4] For example, MPOs developing the MTP must consult, as appropriate, "…State and local agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation."[5] States developing the LRTP must consult with MPOs, regional transportation planning organizations (RTPOs), Tribal governments, and state and local agencies.[6] Any interested parties should be included, as well as the general public, transportation providers, and representatives of system users.[7]

Items to keep in mind when collaborating and coordinating on the development of goals and objectives:

- Document planning timelines to more easily identify opportunities for collaboration
- Ensure a diverse group of stakeholders are invited to participate
- Establish working groups or similar structures with the primary purpose to develop goals and objectives
- Consider how each agency or partner will value particular goals
- Support staff participating in collaborative efforts by reducing workload temporarily

Cross reference: Component 01: Strategic Direction, Step 1.1.3

Measures

Once the agency has established goals and objectives and understands what data are available, partners can be engaged to identify and define performance measures. Obtaining input from various groups will help identify opportunities to use the same measure across multiple agencies, which can streamline how data are collected, managed, and analyzed. In some cases, it is feasible to reconcile similar measures used by partners into common measures. Be prepared for situations where partner agencies, while using similarly-named measures, are actually using different underlying calculations. Even though using the same measures across agencies may improve data interoperability, agencies should be careful not to

[4] 23 CFR § 450.210 (a)(1)(vii) 316 (a)(1)(vii). 49 CFR 613.
[5] 23 USC § 134 (i)(5)
[6] 23 USC § 135 (f)(2)
[7] 23 USC § 134 (i)(6) and 23 USC § 135 (f)(3)

STEP B.1.1	Engage with external stakeholders to establish goals, objectives, and measures

use measures only because data already exist or the measures are more affordable. Measures must be meaningful and add value to the later processes of target setting, planning, programming, and monitoring to produce results that meet the expectations for the traveling public, businesses, and communities. It is also important to consider how readily understood measures will be by the public. Reporting will be easier if measures are inherently straightforward; however, some measures that are good for public consumption fail to be useful for internal agency management.

Collaboration and coordination between State DOTs and MPOs can be beneficial because these agencies have traditionally used measures for different purposes: State DOTs to track trends in asset condition and direct outputs, and MPOs for forecasting and alternatives planning. A robust TPM practice requires both.

Discussion with partners should:

- Engage technical and nontechnical individuals
- Determine whether measures are forecastable or measurable with existing tools and data

Cross reference: Component 01: Strategic Direction, Step 1.2.2

Examples

Public Engagement for Goal Setting: Binghamton MPO[8]

Spurred by a declining population and the need to update the LRTP, the Binghamton Metropolitan Transportation Study (BMTS), the MPO for the Binghamton, NY region, undertook an extensive external engagement process to identify community goals. Their first step was to create a Community Vision Team that included a representative cross-section of the community:

- Students and administrators from Binghamton University
- Human service providers
- Elected officials
- Business and economic development representatives
- BMTS staff

Facilitators presented the team with summaries of goals from local planning and economic development documents to discuss in a series of meetings. While there were some challenges in keeping all members of the team continuously engaged, the biggest challenge was convincing local elected officials and planning staff from different agencies to participate in a cooperative dialogue.

The previous LRTP lacked a clear community vision, but the updated plan reflects the goals proposed by the Community Vision Team, emphasizing how external engagement can link community goals to agency planning. In a reminder that internal buy-in is also critical, those involved noted that success hinged on the support of the MPO leadership who approved a departure from traditional methodology.

Cross reference: Component 01: Strategic Direction, Step 1.1.3

[8] FHWA PlanWorks Application. *Binghamton Metropolitan Transportation Study: Scenario Planning Yields Community Vision of Revitalized Urban Centers*. https://fhwaapps.fhwa.dot.gov/planworks/Reference/CaseStudy/Show/12.

STEP B.1.1	Engage with external stakeholders to establish goals, objectives, and measures

Partner and Public Engagement: MTC PlanBayArea 2040

The Metropolitan Transportation Commission, the MPO for the San Francisco Bay Area, is currently updating its Regional Transportation Plan, known as Plan Bay Area 2040. To engage external stakeholders, MTC assembled a Performance Working Group comprised of representatives from cities; counties; transit agencies; congestion management agencies; the state; economic, equity, and environmental organizations; and members of the Policy Advisory Committee, made up of citizen representatives. This comprehensive group was engaged to develop goals and performance targets for the plan update.

To inform the working group, staff led public workshops during which goals from the original Plan Bay Area (adopted in 2013) were presented as a starting point; attendees voted for their top three most important. Once voting was complete, individuals were asked what goals were missing and wrote their ideas on sticky notes to assemble on the wall. This low-tech word cloud was assembled into the digital version shown in Figure B-2, with word size indicating the relative number of comments posted by participants.[9]

Figure B-2: MTC Collaborative Goal Setting

Source: Plan Bay Area 2040 Spring 2015 Public Engagement Report[10]

[9] Metropolitan Transportation Commission and Association of Bay Area Governments. (2015). Plan Bay Area 2040 Spring 2015 Public Engagement Report. http://planbayarea.org/file10232.html

[10] Metropolitan Transportation Commission and Association of Bay Area Governments. (2015). Plan Bay Area 2040 Spring 2015 Public Engagement Report. http://planbayarea.org/file10232.html

STEP B.1.1	Engage with external stakeholders to establish goals, objectives, and measures

Water was a top goal area because of the ongoing drought. MTC staff noted that social equity, in terms of affordable housing, was elevated as a major concern in this RTP cycle, while economic vitality was a lower priority because of the current strength of the area's economy. This engagement process demonstrates how important it is for an agency to engage stakeholders on an ongoing basis because priorities can and do shift based on changing conditions. Staff also note that stakeholder understanding of the impact of this process has increased each cycle; selection of goals can be contentious because stakeholders know that plan goals do in fact determine which projects are funded and how discretionary funding is allocated.

Cross reference: Component 01: Strategic Direction, Step 1.1.3

Measure Selection: Maryland Attainment Report Advisory Committee

As of 2000, Maryland law requires publication of an annual Attainment Report that includes performance indicators to track progress toward achievement of goals and objectives in the Maryland Transportation Plan (LRTP) and the Consolidated Transportation Program (6-year capital budget).[11] The law was updated in 2010 to create an Attainment Report Advisory Committee comprised of specific stakeholders such as:

- A representative of rural interests
- A representative of an auto users group
- A representative of a transit-user's group
- A nationally recognized expert on pedestrian and bicycle transportation
- A nationally recognized expert on transportation performance management
- And others

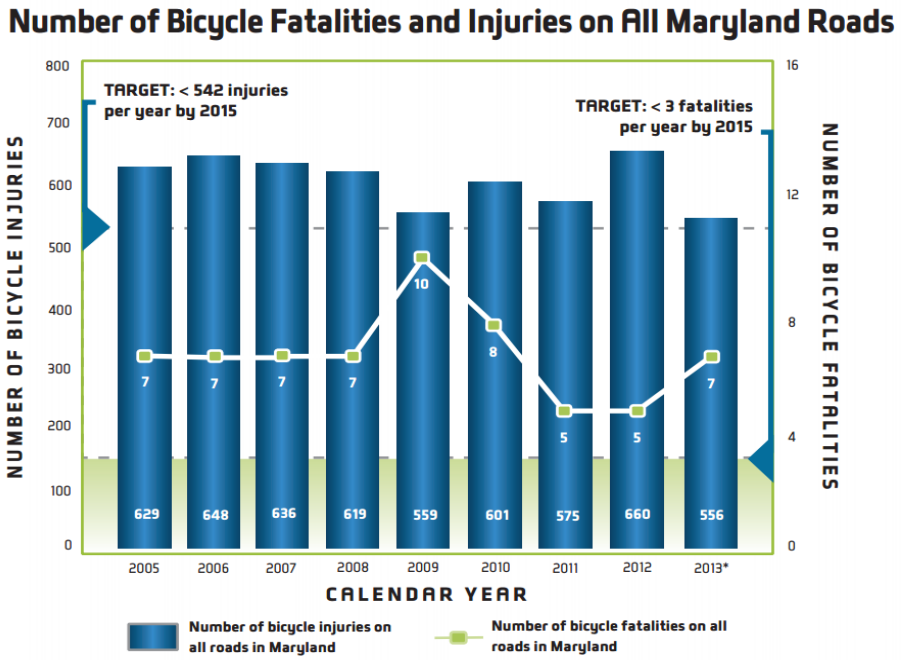
The committee is charged with reviewing use of performance measures in other states to advise MDOT on goals, benchmarks, and performance measures. An example of such a measure is below in Figure B-3. MDOT staff as well as staff from the modal administrations within the department work with the committee to develop performance measures each time Maryland's long-range plan is updated or every three years.

[11] Transportation Article Section 2-103.1 of the Annotated Code of Maryland.

STEP B.1.1	Engage with external stakeholders to establish goals, objectives, and measures

Figure B-3: Measuring Safety for Bicycle and Pedestrians at MDOT

Source: 2015 Annual Attainment Report[12]



Cross reference: Component 01: Strategic Direction, Step 1.2.2

Linkages to Other TPM Components	Component 01: Strategic Direction Component 02: Target Setting Component 03: Performance-Based Planning	(See TPM Framework)

STEP B.1.2	Collaboratively establish targets

Description

The first step in establishing targets is to assemble data to develop a baseline for selected performance measures. Partner agencies should initiate discussions to determine what data are available within each agency's data system. Understanding what data are available will be helpful to determine what information can be considered as a baseline is established.

Working groups can be established to coordinate target setting; members of these groups should include DOT, MPO, and transit agency staff, as well as staff from other partners. With a formalized group dedicated to cross-agency collaboration, work is more likely to be sustained. Ensure working group members have support from management and leadership to dedicate the necessary time to such working groups so that each meeting can be productive. For performance areas that are heavily affected by influencing factors, consider including

[12] Maryland Department of Transportation. (2015). 2015 Annual Attainment Report. Baltimore, MD. http://www.mdot.maryland.gov/Office_of_Planning_and_Capital_Programming/CTP/CTP_15_20/CTP_Documents/2015_Final_AR.pdf

STEP B.1.2	Collaboratively establish targets

representatives from non-transportation partners to understand the impact of these influencing factors on historical and projected performance. Often these partners will bring information to the table that allows understanding of why trend data varied over time.

Working groups should continue to meet even after targets have been established. This will promote closer collaboration in the future as targets are updated and performance data are monitored to determine target attainment.

Consider starting with a single performance area to build the processes and structures for collaboration and coordination. Once any challenges have been addressed, expand to other performance areas.

Data consistency can be an obstacle to collaborative target setting. If partners are using different data sets, baselines and forecasts may differ. To overcome this obstacle, consider using grant money or other funding to make a single data set available to all partners.

Collaboration in target setting could also take the form of benchmarking with peer agencies. Gathering target information from peer agencies can clarify regional and national trends in specific performance areas, create a context for a target, and help explain a proposed target's value to external stakeholders. However, to properly bring external target values into an internal agency's target setting process requires accurately identifying peer agencies (or clearly explaining the differences), confirming that similar data sources were used, and ensuring consistent measure definitions were applied.

As with any process in TPM, it is vital to document the steps taken, staff involved, and roles and responsibilities. Because targets will need to be updated regularly, having this information documented will make updates straightforward and efficient.

Other collaboration and coordination techniques include:

- Obtain agreement among partners concerning assumptions and inputs to models
- Hold working group meetings on a regular basis to prevent coordination from losing momentum
- Invite State DOT representatives to sit on MPO boards
- Compose a joint statement of understanding regarding data sources, desired outcomes, and other assumptions
- Promote data consistency by using grant money or other funding to make data available to all partners
- Define roles and responsibilities both within and across agencies to ensure all offices are engaged[13]

[13] Federal Highway Administration. (2014). *Target Setting Peer Exchange: Summary Report*. https://www.planning.dot.gov/Peer/Arizona/scottsdale_6-17-14_FHWA_target_setting.pdf

STEP B.1.2	Collaboratively establish targets

Examples

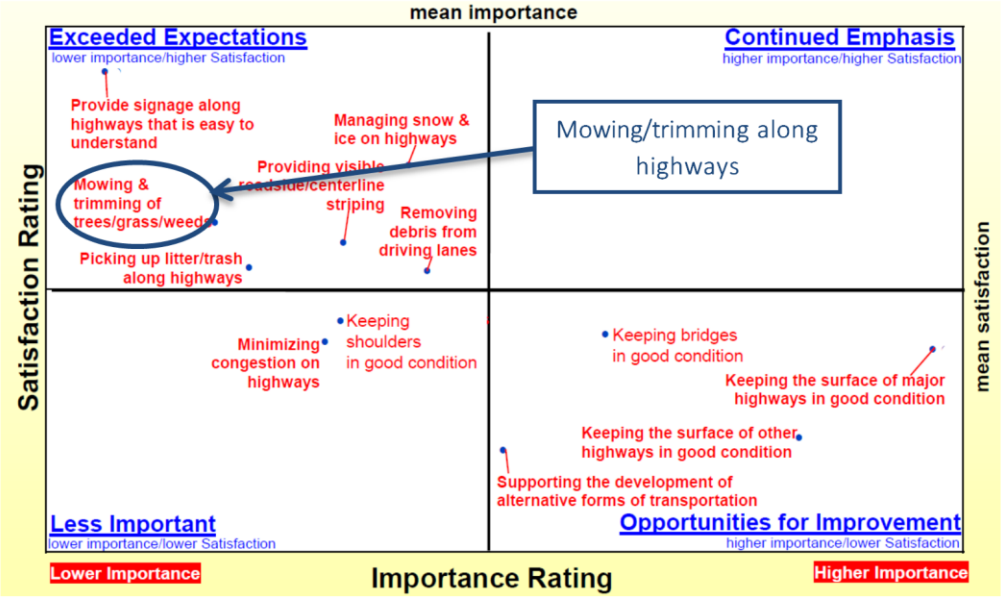
Understanding Tolerable Thresholds: MoDOT

Missouri DOT's customer report card includes an importance-satisfaction analysis that plots the percentage of Missourians who indicated a service offered by MoDOT as very important against the percentage of Missourians who were very satisfied (or dissatified) with that service. The simple graphic provides guidance on where to focus resources. For example, in 2010 when the agency was facing a notable funding shortfall, the importance-satisfaction chart highlighted an opportunity to shift resources from one service to another. As the figure below from 2010 illustrates, Missourians were relatively satisfied with MoDOT's mowing/trimming services, but overall this was of less importance to citizens than other services. Subsequently, MoDOT reduced its mowing practices from four to three times a year resulting in $2.5 million in savings that was reallocated to other system performance areas. The next survey showed this maintenance practice change had zero effect on customer satisfaction. This information is important to know as the agency sets targets for performance in various areas.

> "Public opinion surveys can also be helpful in the target-setting process to understand the relationship between different transportation system performance levels and the level of inconvenience or discomfort perceived by users."
>
> Source: NCHRP 551: Performance Measures and Targets for Transportation Asset Management (Vol II, pg. 34)

Figure B-4: Satisfaction v. Importance of Agency Activities

Source: Adapted from A Report Card From Missourians (2010)[14]



Cross reference: Component 02: Target Setting, Step 2.2.4

[14] Missouri Department of Transportation. (2010). A Report Card From Missourians – Appendix A: I-S Analysis. Jefferson City, MO. https://library.modot.mo.gov/RDT/reports/Rd08018/or11001apdxA.pdf

STEP B.1.2	Collaboratively establish targets

Target Setting Collaboration: WSDOT[15]

The Washington State DOT has established three groups to facilitate collaborative target setting. The Target Setting Framework Group includes representatives from WSDOT and directors of MPOs and meets quarterly to address issues in three categories: process, data, and target setting.

- Process: the group will decide when and how often WSDOT and MPOs should engage and how to engage.
- Data: the group will determine what types of data to use, establish roles and responsibilities for data collection and analysis, and the process MPOs should use to report targets and results.
- Target setting: the group will advise on target setting decisions, with final recommendations forwarded to MPOs, WSDOT's Executive Leadership Team, and the Secretary of Transportation. Agencies can adopt or modify the targets, but the Secretary must ensure they align with the Governor's strategic directions.

The Target Setting Working Group, a smaller group comprised of WSDOT and MPO staff, meets monthly to discuss policy and process issues more in depth to prepare recommendations for the Framework Group.

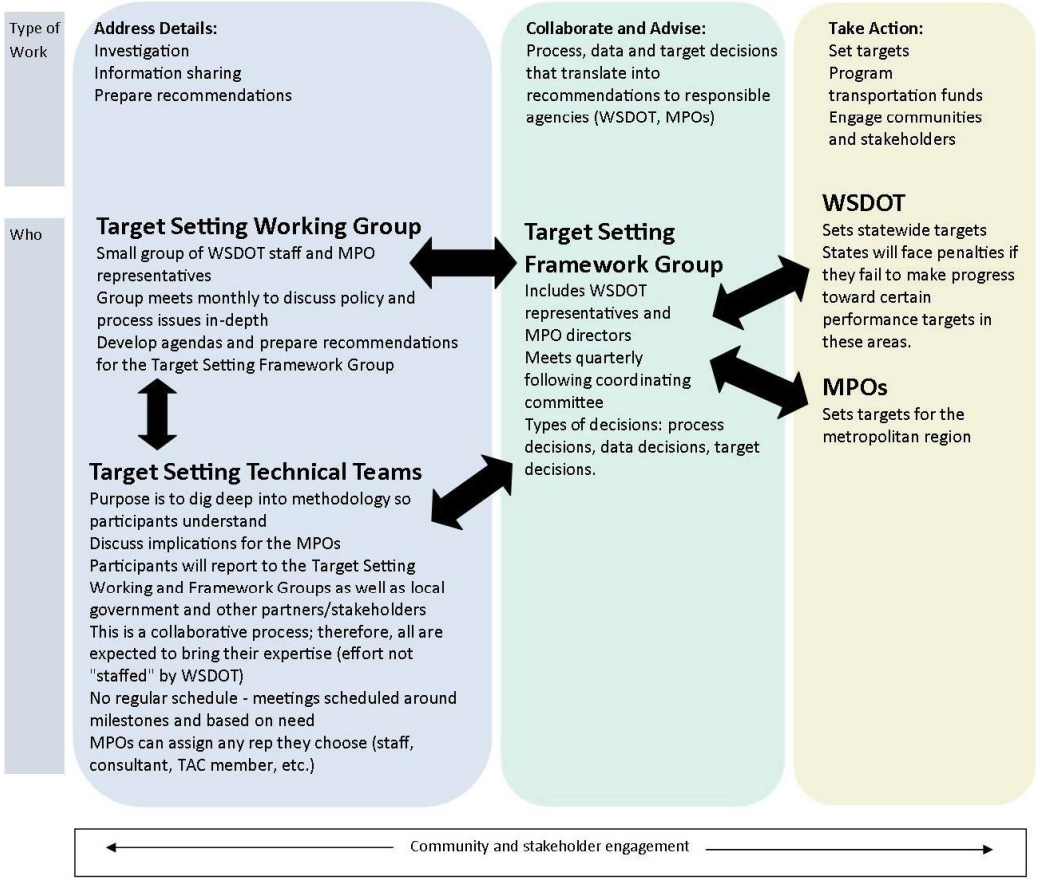
Target Setting Technical Teams go into more detail, using NPRMs to prepare for new requirements by analyzing and vetting WSDOT proposed targets. Each national performance area has a technical team that reports to the Working Group and Framework Group and individual members report back to WSDOT, their MPO, and local government partners. Technical Teams meet as needed, mainly around milestones.

[15] Washington State DOT. *MAP-21 Collaboration*. May 2015 – Edition 1. http://wsdot.wa.gov/NR/rdonlyres/31492B5E-0908-4B44-B910-8669DBEB0E37/0/CollaborationMAP21WSDOTFolio.pdf

STEP B.1.2	Collaboratively establish targets

Figure B-5: WSDOT Target Setting Collaboration Structure

Source: MAP-21 Collaboration, May 2015 – Edition 1[16]



Coordination in Target Setting for California Greenhouse Gas Emissions Reduction

California has formally established performance targets related to greenhouse gas (GHG) emissions reductions. This was done largely as a result of state legislation requiring GHG reduction targets, which resulted in a statewide effort to identify a set of common performance measures.

As a result of the legislation, the California Air Resources Board convened an MPO and state agency working group to talk through the target setting process. An advisory committee of 21 members with representatives from MPOs, housing agencies, ARB, environmental justice groups, and others provided recommendations on how to establish targets. It was important to all these agencies that target setting not be done in a top-down manner. Throughout this process, each MPO conducted modeling to report on the GHG reduction progress it expected to achieve. For example, San Diego Association of Governments, the MPO for San Diego, had

[16] Washington State DOT. *MAP-21 Collaboration*. May 2015 – Edition 1. http://wsdot.wa.gov/NR/rdonlyres/31492B5E-0908-4B44-B910-8669DBEB0E37/0/CollaborationMAP21WSDOTFolio.pdf

STEP B.1.2	Collaboratively establish targets
	relatively sophisticated modeling and forecasting capabilities and therefore was able to analyze various pricing strategies and model expected impacts on GHG reduction targets for cars and trucks. In addition to the working group's efforts, bi-monthly meetings of planning directors from all MPOs in California kept the momentum going for a collaborative target setting process, while the executive directors of large MPOs meet quarterly to exchange assumptions and talk through the key issues they are facing. Even though all regions have now set GHG performance targets, the working group continues to meet. The various coordination efforts between state agencies and MPO to set GHG targets has positioned Caltrans and California's MPOs to work within existing structures for strong coordination in setting other performance targets.
Linkages to Other TPM Components	Component 02: Target Setting (See TPM Framework)

STEP B.1.3	Develop and implement strategies in a collaborative manner
Description	While selecting goals and measures and establishing targets in collaboration with partners is important, it is critically important that collaboration and coordination continues through the development and implementation of strategies. Major efficiencies can be leveraged through coordination in this realm especially concerning cross-jurisdictional and multimodal projects. The issue of internal and external agency silos is a common problem, and staff should attempt robust collaboration to overcome this obstacle. Proactive communication through programming will enable partners to capitalize on synergies and avoid conflicts. A resurfacing project can be combined with pedestrian improvements undertaken by the transit agency around a station to avoid construction disruption over two separate time periods. Or reevaluation of traffic signal timing can be coordinated with a bike lane and signal installation study. A formal input process for collecting project information should be established to simplify the process. Once effective processes for communication, collaboration, and coordination have been identified, document how they were completed. This will ensure proactive communication continues despite staff or other changes. "The collaboration issue is huge – however, to be successful you need to identify and address the institutional barriers within agencies that prevent it from happening." - Susan Sharp, Sharp & Company Agencies that have begun this process of collaborative planning and programming agree that incremental process improvements are valuable, and agencies should not wait until the ideal approach is possible. Additionally, collaboration seems to break down at the point when one agency becomes responsible for funding and implementing a particular project because results

STEP B.1.3	Develop and implement strategies in a collaborative manner

of collaboration must compete with other priorities within the agency. To combat this, an agency should try to maintain coordination at both upper management and technical levels.[17]

The public and partners both will play a key role in examining alternative investment and policy scenarios, and partners will provide input to inform the selection of preferred strategies. Within this process, stakeholders can rely upon performance information and the results of analysis from the agency to help in understanding the implications of different investment and policy scenarios, and can react to these results and express preference.[18]

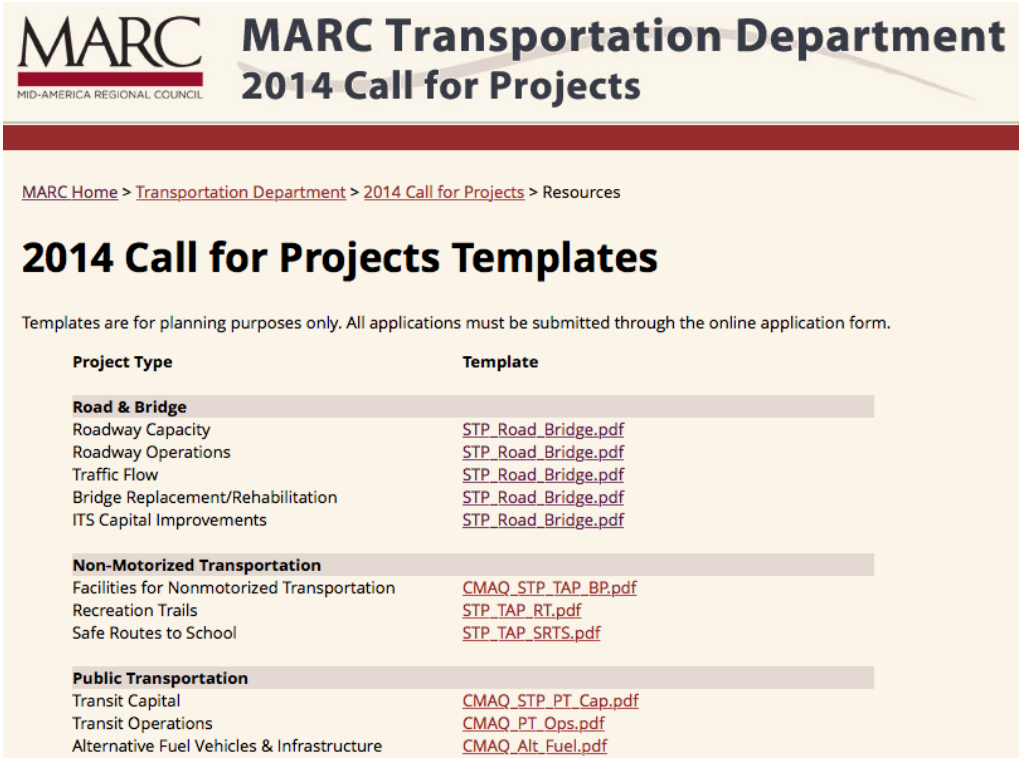
> "There is a lot of emphasis on external collaboration during transportation planning, but it seems to fall off during programming. Agencies should do as much during programming as they do during planning."
>
> - FHWA planning staff

Examples

Staff at the **Mid-America Regional Council (MARC)**, the MPO for the greater Kansas City area, developed an online template library to gather calls for projects for programming efforts.

Figure B-6: MARC Project Templates

Source: MARC Transportation Department[19]



MARC
MID-AMERICA REGIONAL COUNCIL

MARC Transportation Department
2014 Call for Projects

MARC Home > Transportation Department > 2014 Call for Projects > Resources

2014 Call for Projects Templates

Templates are for planning purposes only. All applications must be submitted through the online application form.

Project Type	Template
Road & Bridge	
Roadway Capacity	STP_Road_Bridge.pdf
Roadway Operations	STP_Road_Bridge.pdf
Traffic Flow	STP_Road_Bridge.pdf
Bridge Replacement/Rehabilitation	STP_Road_Bridge.pdf
ITS Capital Improvements	STP_Road_Bridge.pdf
Non-Motorized Transportation	
Facilities for Nonmotorized Transportation	CMAQ_STP_TAP_BP.pdf
Recreation Trails	STP_TAP_RT.pdf
Safe Routes to School	STP_TAP_SRTS.pdf
Public Transportation	
Transit Capital	CMAQ_STP_PT_Cap.pdf
Transit Operations	CMAQ_PT_Ops.pdf
Alternative Fuel Vehicles & Infrastructure	CMAQ_Alt_Fuel.pdf

[17] American Association of State Highway and Transportation Officials, Standing Committee on Planning. (2012). *Performance-Based Planning and Programming Pilots* (NCHRP Report 08-26, Task 104).
[18] FHWA. (2014). *Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning*. FHWA-HEP-14-046.
[19] Mid-American Regional Council Transportation Department. (2014). Kansas City, MO.

STEP B.1.3	Develop and implement strategies in a collaborative manner

The online call for projects page is currently in use for multiple plans, including MARC's Surface Transportation Program 2017-2018, Transportation Alternatives (TAP) 2014-2018, and Congestion Mitigation and Air Quality Improvement Program 2015-2018. Projects are evaluated based on how closely they align with policy goals, making clear the connection between goals and programmed projects.

The input uses a menu to gather basic information on the project such as program, location, need, modes, description, usage, and relationship to or inclusion in a number of other plans. This allows MARC to receive a large amount of information from a large number of users while simultaneously organizing it into a database-friendly format that allows staff to see connections between projects that could be opportunities for collaboration.[20]

Cross reference: Component 04: Performance-Based Programming, Step 4.1.3

Massachusetts Department of Transportation (MassDOT)

Section 11 of Chapter 46 of the Acts of 2013 established a Project Selection Advisory Council charged with developing uniform project selection criteria for cross-modal programming.[21] MassDOT integrated separate transit, highways, aeronautics, and a division of motor vehicles into a fully multimodal agency; collaboration among the divisions is a critical factor for success as the agency moves toward cross-modal prioritization in programming.

Council members were appointed by the legislature, with the MassDOT Secretary as chair. Members comprised representatives from MassDOT, such as the General Manager of the Massachusetts Bay Transportation Authority (MBTA) as well as representatives from external organizations. The Council included a policy and planning expert, a transportation finance expert, an engineer, a regional planning association representative, and a municipal representative.

Over an 18-month period, the Council met regularly and consulted with the public and legislature. On July 1, 2015, "Recommendations for MassDOT Project Selection Criteria" was delivered, focusing primarily on modernization and capacity projects.

As a result of the Council's final report, a Stakeholder Advisory Committee was created to include key external stakeholders (RTAs, MPOs, and municipalities) who would be impacted by implementation. An internal Implementation Committee was also created as a result of the Council's final report. With assistance from the Stakeholder Advisory Committee, the Implementation Committee is responsible for developing guidance for project scoring and managing implementation of the framework as a whole within the agency.

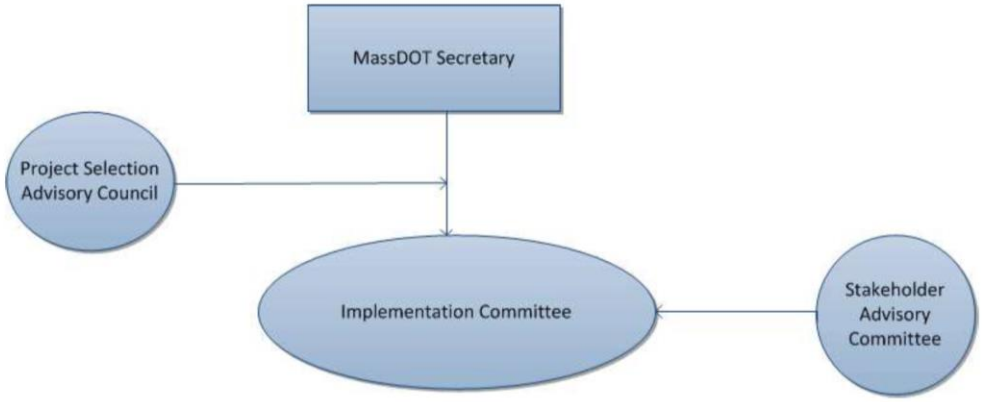
[20] Mid-America Regional Council. Congestion Mitigation/Air Quality Surface Transportation Program Transportation Alternatives Program http://www.marc2.org/tr-call/index.aspx and 2014 Call for Project Templates http://www.marc2.org/tr-call/templates.aspx

[21] Massachusetts Department of Transportation. (2015). Recommendations for MassDOT Project Selection Criteria. Boston, MA. https://www.massdot.state.ma.us/Portals/0/docs/PSAC/Report_Recom.pdf

STEP B.1.3	Develop and implement strategies in a collaborative manner

Figure B-7: MassDOT Collaboration Structure

Source: Recommendations for MassDOT Project Selection Criteria[22]



Agency Collaboration in the Washington, DC Region[23]

A pilot program facilitated by the American Association of State Highway and Transportation Officials (AASHTO) sought to establish methods to collaboratively identify and implement multimodal, cross-agency congestion reduction strategies with a number of agencies in the Washington, DC area:

- MD State Highway Administration
- National Capital Regional Transportation Planning Board/Metropolitan Washington Council of Governments
- Washington Metropolitan Area Transit Authority
- Maryland National Capital Park and Planning Commission
- Montgomery County

The research team facilitated discussion among the agencies to determine a six-step methodology for identifying, prioritizing, and implementing multimodal congestion strategies in a "hotspot" location. One location was selected from a larger list of bus priority hotspots compiled based on frequency and speed data as well as ridership and agency assessments. The final location was selected through discussions between agency representatives who prioritized the list from their agency's perspective, avoiding locations where projects were already underway, and prioritizing locations where bus and auto needs aligned, and where data were available to assess the auto perspective.

The methodology established is detailed in Table B-4, and further detail about how steps were conducted is provided in Figure B-8.

[22] Massachusetts Department of Transportation. (2015). Recommendations for MassDOT Project Selection Criteria. Boston, MA. https://www.massdot.state.ma.us/Portals/0/docs/PSAC/Report_Recom.pdf

[23] American Association of State Highway and Transportation Officials, Standing Committee on Planning. (2012). *Performance-Based Planning and Programming Pilots* (NCHRP Report 08-26, Task 104).

STEP B.1.3	Develop and implement strategies in a collaborative manner

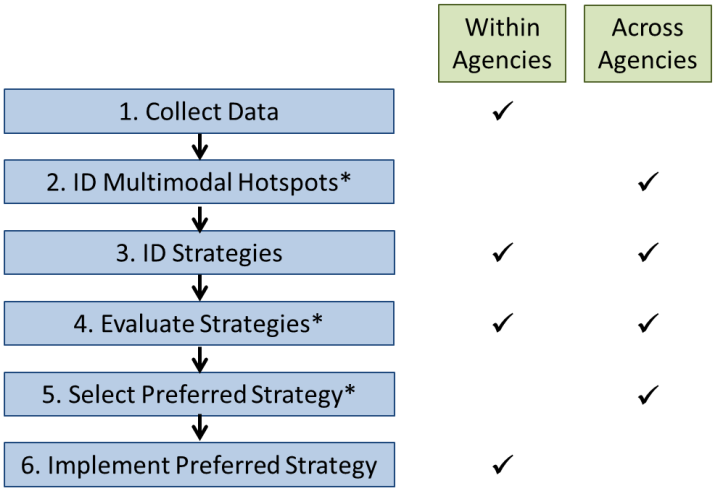
Table B-4: AASHTO Collaborative Congestion Reduction Steps

Source: Performance-Based Planning and Programming Pilots[24]

Step	Description
1. Collect Data	Individual agencies collect data to support evaluation of their systems.
2. Identify Hotspots	Inventory data across agencies and collaborate to identify shared priorities. Use totality of data to identify a large list of multimodal hotspots and afterwards obtain input from roadway agencies.
3. Identify Strategies	All agencies suggest potential strategies and provide guidance on viability and effectiveness of each. Filter projects that are not possible or appropriate for context.
4. Evaluate Strategies	Come to agreement on evaluation methodology, criteria, and performance measures to use to compare and prioritize strategies.
5. Select Preferred Strategy	Select preferred strategy collaboratively, based on evaluation of expected performance and costs.
6. Implement Preferred Strategy	The appropriate implementing agency programs, funds, constructs, and operates the strategy.

Figure B-8: AASHTO Collaborative Congestion Reduction Process Flowchart

Source: Performance-Based Planning and Programming Pilots[25]



[24] American Association of State Highway and Transportation Officials, Standing Committee on Planning. (2012). *Performance-Based Planning and Programming Pilots* (NCHRP Report 08-26, Task 104).

[25] American Association of State Highway and Transportation Officials, Standing Committee on Planning. (2012). *Performance-Based Planning and Programming Pilots* (NCHRP Report 08-26, Task 104).

STEP B.1.3	Develop and implement strategies in a collaborative manner
	After the pilot, agency representatives were interviewed concerning challenges and potential solutions. Some of the important themes included: • A desire to combine roadway and transit measures to develop person-based, mode-neutral measures such as delay per traveler. This would make evaluation of multimodal projects easier. • Identification that the biggest challenge within the process is moving from step 5 to 6, when the implementing agency must follow through to program and fund selected projects. Possible solutions included 1) implementing agencies create line item programs specifically for collaboratively-identified projects, 2) agencies maintain a list of priorities and attach improvement to large, mode-specific projects as they are programmed, 3) develop communications techniques to target decision makers at implementing agencies to highlight the performance implications of preferred strategies, and 4) include key staff from implementing agencies early in the process to establish buy-in.
Linkages to Other TPM Components	Component 04: Performance-Based Programming (See TPM Framework)

B.2 MONITORING AND REPORTING

Steps in this subcomponent will assist agencies in external collaboration and coordination related to monitoring and reporting.

1. Implement data sharing protocols
2. Review and discuss content of reports to ensure consistent messaging
3. Formalize process for monitoring and reporting

> "Coordination between agencies can be especially helpful, given the vast amount of data being collected by different agencies… [and the need to] balance the need for frequent information updates with the need to use resources [efficiently]."
>
> Source: FHWA, Performance Based Planning and Programming Guidebook

STEP B.2.1	Implement data sharing protocols
Description	Successful monitoring depends on data collection and usability; therefore, a fundamental aspect of external collaboration and coordination within TPM is data sharing. Data collaboration and coordination opportunities can be pursued to lower costs of existing data programs or to investigate ways of tapping into additional data sources from partner agencies to supplement what is already collected. With respect to existing data programs, a logical starting point for identifying opportunities for data collection efficiencies is a compilation of existing initiatives and their costs. This information can help the agency to target areas with substantial costs. Resiliency to severe weather incidents is becoming a prominent concern, and preparing for such events will require partnership with external agencies to obtain climate forecasts.

> "It became readily apparent that different departments were collecting duplicate data sets and that working together we could invest in a data set worthy of… our goals."
>
> - Stan Burns, Utah DOT

Specific opportunities can be sought for data collaboration and coordination to make best use of available resources.

These may include:

- Consolidating data collection initiatives–for example, collection of curve and grade data for safety analysis as part of automated pavement data collection.
- Utilizing video-logs or LiDAR imagery to extract multiple data attributes.
- Designating responsibilities for updating data about highway inventory and condition as an integral part of construction project closeout and maintenance management processes–to reduce the need for complete re-collection of data.
- Establishing a data clearinghouse that facilitates sharing of data collected by multiple agencies.
- Maintaining an agency data catalog and requesting that staff check existing data availability prior to embarking on new data collection efforts.
- Establishing data sharing agreements with private sector organizations–for example, to obtain real time travel information in exchange for information about construction schedules and reported incidents.
- Collaborating with regional partners to share costs of acquiring data sets of common interest.
- Coordination of data collection across multiple jurisdictions through a regional or

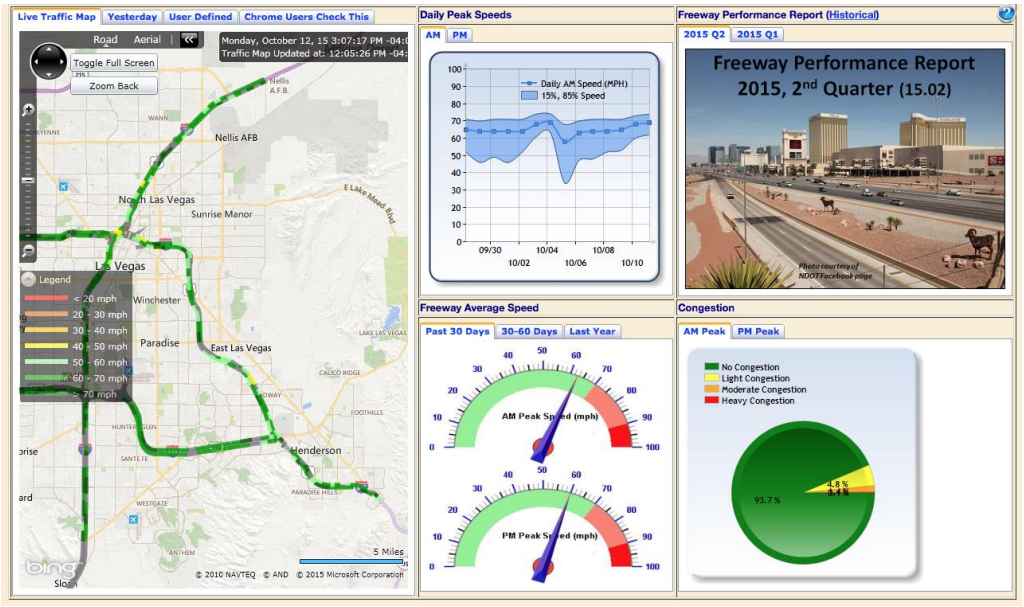
STEP B.2.1	Implement data sharing protocols
	statewide body that sets standards and provides support for consistent data collection and reporting, and consolidates the reported data. • Incorporating a system-wide, multimodal view by integrating data from various modal agencies or divisions. Once appropriate strategies are identified, work will be required to negotiate agreements. Data sharing agreements need to lay out processes, roles, responsibilities, and financial arrangements (each party's contribution–both direct and in-kind). Negotiations will typically also involve discussions to ensure that each party's data requirements will be addressed–considering accuracy, precision, and fit with reporting and analysis timetables. After implementing data sharing agreements, the initiatives should be continuously monitored to ensure they are fulfilling agency needs. If possible, include a reevaluation trigger or time period within the agreement.
Examples	**Collaborative Monitoring: Freeway and Arterial System of Transportation (FAST)** The FAST system is a comprehensive monitoring effort that develops, implements, and maintains an Intelligent Transportation System (ITS) administered by the Regional Transportation Commission (RTC) in conjunction with the Nevada Department of Transportation (NDOT). The system includes coordinated traffic monitoring cameras, signal timing, and a portfolio of projects such as ramp metering and informative signage aimed at reducing congestion and improving user experience along major corridors. The RTC elected board develops policies for FAST, while transportation strategies are set by the Operations Management Committee (OMC), comprised of representatives from RTC, Clark County, NDOT and the cities of Henderson, Las Vegas, and North Las Vegas. RTC staff is responsible for the Arterial Management Section, which includes all arterial streets and roadways, and the Freeway Management Section, which includes the entire freeway network.[26] Recent analysis of incidents on FAST revealed the impacts of large downtown conventions on the traffic patterns of Las Vegas' major corridors. Closely examining these patterns enables RTC and partners in NDOT and the Metropolitan Police to better manage such large events and the traffic demands they entail. This includes the impact of police traffic direction, which assists by prioritizing access to and from event locations, but also contributes to corridor delays and beyond.

[26] Freeway and Arterial System of Transportation (FAST). June 14, 2016. http://www.rtcsnv.com/planning-engineering/freeway-arterial-system-of-transportation-fast/

STEP B.2.1	Implement data sharing protocols

Figure B-9: NDOT Coordinated Traffic Monitoring Interface

Source: FAST Dashboard[27]



Cross reference: Component 05: Monitoring and Adjustment, Step 5.2.1

Shared Database: Metro Regional Centerline Collaborative (MRCC)[28]

The MRCC is a joint collaborative project involving GIS technical and managerial staff from the seven-county Minneapolis-St. Paul metropolitan area, the Metropolitan Emergency Services Board, and the Metropolitan Council, the area's MPO. This group is facilitating the development and maintenance of an authoritative, inter-jurisdictional, publicly available road centerline data model and data set. It is doing this by having each county provide data according to specified standards.

Once completed, intended use of the data model and data set will include:

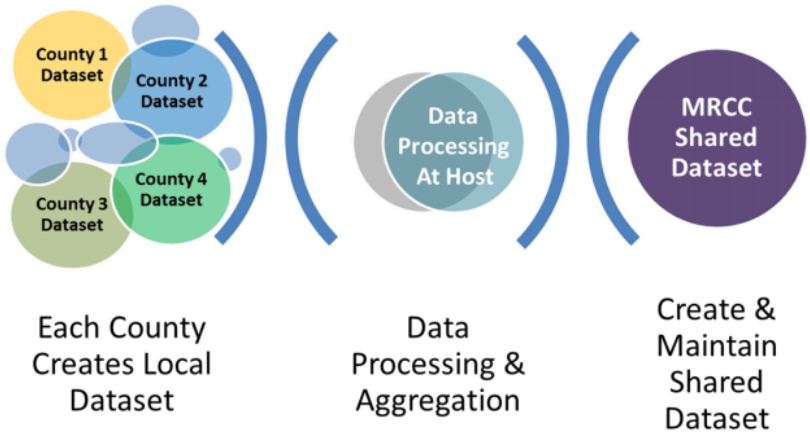
- Vehicle routing;
- Address geocoding;
- Next Generation 911 call routing and location validation;
- Emergency services dispatching;
- Linear referencing system use; and
- Cartographic road feature representation.

[27] Nevada Department of Transportation - RTC FAST Dashboard. March 2, 2016. http://bugatti.nvfast.org/Default.aspx
[28] MetroGIS, Metro Regional Centerline Collaborative. http://metrogis.org/projects/centerlines-initiative.aspx.

STEP B.2.1	Implement data sharing protocols

Figure B-10: MRCC Data Pooling Methodology

Source: MRCC Regional Data Maintenance Project [29]



Cross reference: Component C: Data Management, Step C.4.1

UPlan: Utah Department of Transportation:[30]

Utah DOT has created the UPlan interactive mapping platform to improve data sharing. UDOT can integrate any publicly-available spatial data into UPlan. Stakeholders can also share geospatial layers with UDOT, which improves collaborative decision-making by ensuring that the agency and stakeholders can view the same information (e.g., for assessing project impacts). UDOT can change access permissions, enabling it to use and share different data sources securely.

[29] Metro Regional Centerline Collaborative. (2015). MRCC Regional Data Maintenance Project. Minneapolis, MN. http://www.metrogis.org/getmedia/61cfce67-2f56-4095-980b-42bd4c257f1f/MRCC-First-Build-Charter-2015_08_03.pdf.aspx

[30] Federal Highway Administration. "Utah's GIS Database Enhancing Transportation Performance Management," TPM Noteworthy Practice Series http://www.fhwa.dot.gov/tpm/noteworthy/hif13022.pdf.

STEP B.2.1	Implement data sharing protocols

Figure B-11: UDOT Project Templates

Source: UPlan: UDOT Map Center [31]

Cross reference: Component C: Data Management, Step C.4.1

Linkages to Other TPM Components	Component 05: Monitoring and Adjustment (See TPM Framework) Component C: Data Management Component D: Data Usability and Analysis

STEP B.2.2	Review and discuss content of reports to ensure consistent messaging

Description

Before an agency reports performance results to external audiences, staff should coordinate with partners to ensure consistent messaging across agencies. These partners at time may be part of the discussion; at other times they may be recipients of reporting. Regardless, stakeholders desire information that is easy to understand, and conflicting messages from different agencies does not fulfill that desire. Agencies must also tailor reporting to external audiences; what makes sense internally will not often translate to the public and elected officials.

In addition, reporting by one agency will impact another when targets are exceeded, attained, or missed. For example, one agency could attain a target, while another falls short of a similar target. When these agencies are within the same region, they are typically subject to similar influencing factors. Stakeholders may not understand why one target could be attained and the other missed. Partners also impact the reporting agency's performance; these impacts should be discussed in the report. Engagement benefits the agency by potentially reducing negative attention stemming from poor performance.

[31] UPlan: UDOT Map Center. June 14, 2016. http://uplan.maps.arcgis.com/home/

STEP B.2.2	Review and discuss content of reports to ensure consistent messaging

While agencies could simply provide a draft for comment by partners, ideally collaboration and coordination starts earlier and is more robust. Agencies can integrate reporting, using the same schedule and the same format while still reporting individual data. Partners should collaborate to develop a communications plan that lays out presentation methods, formats, and approaches to ensure messaging is consistent, unified, and cohesive across communications products

> "Measuring performance is of no value unless results are reported to the appropriate audiences in a way that makes the information readily understandable."
>
> Source: NCHRP Report 446: A Guidebook for Performance-Based Transportation Planning

All reports should include interpretation of results using economic indicators, weather events, and other factors, as well as what actions the agency has taken to achieve outcomes. In light of positive or negative performance, agencies should spell out next steps either to continue or correct trends to demonstrate commitment to the public and elected officials. A discussion of coordination between partner agencies can help show that resources are being used effectively and agencies are not working at cross-purposes.

Cross reference: Component 06: Reporting and Communication, Step 6.2.3

Examples

Communicating Performance Website[32]

Hosted by AASHTO, the Communicating Performance website is a library of effective communication pieces tagged by audience, performance area, message, messenger, type, reporting period, and others elements. By applying filters, users can find example resources that can provide direction and inspiration for creation of reports.

Vital Signs Report: Coordinated Reporting Across Partners[33]

The Metropolitan Transportation Commission, the MPO for the San Francisco Bay Area, collaborated with the Association of Bay Area Governments to write PlanBayArea, a comprehensive housing, transportation, and land use strategy document that includes the 2040 RTP. Beyond being a logical combination of integrated issues, the work was prompted by SB 375, the California Sustainable Communities and Climate Protection Act of 2008. This required that every metropolitan area draft a Sustainable Communities Strategy to reduce greenhouse gas emissions from vehicles in part by promoting compact, mixed-use development near transit. PlanBayArea is the Bay Area's Strategy.

PlanBayArea contains a number of regional performance measures which are presented to the public via the Vital Signs portal, a user-friendly and interactive website. The format of the website gives the public a clear understanding of what the performance measures are, what

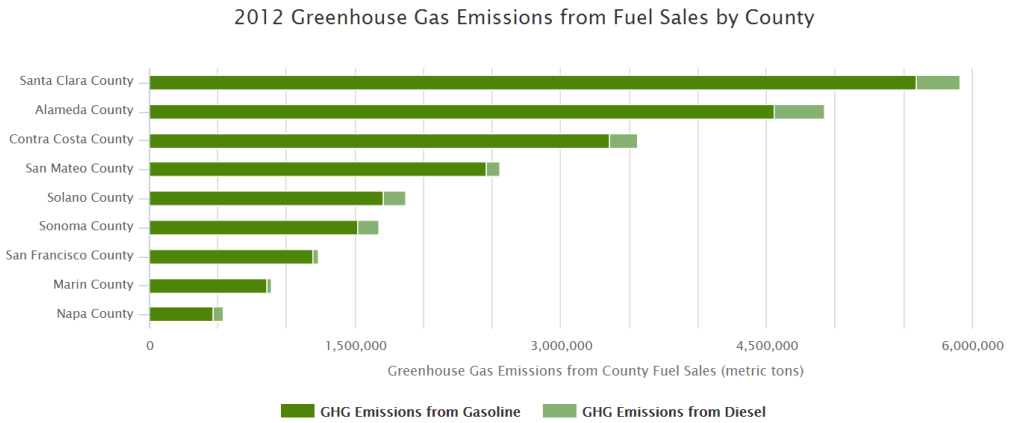
[32] www.communicatingperformance.com
[33] Metropolitan Transportation Commission. *Vital Signs.* http://www.vitalsigns.mtc.ca.gov/

STEP B.2.2	Review and discuss content of reports to ensure consistent messaging

they mean, and how they link to community concerns. It integrates measures from MTC, the Association of Bay Area Governments, the Bay Area Air Quality Management District, and the San Francisco Conservation and Development Commission, enabling external audiences a one-stop shop for these organizations' reporting and thereby maintaining consistent messaging.

Figure B-12: S.F. Bay Area MPO 2012 Greenhouse Gas Emissions from Fuel Sales by County

Source: Vital Signs[34]



Cross reference: Component 06: Reporting and Communication, Step 6.2.3

Incorporating Partner Agency Performance in Reporting: WSDOT

The Washington State DOT publishes The Gray Notebook, a quarterly performance report. It includes a Corridor Capacity Report that communicates not only congestion on highways, but transit and Amtrak ridership. WSDOT has taken a multimodal, holistic approach to reporting by incorporating performance data from other agencies such as Amtrak and Sound Transit and reporting a number of measures for a single commute corridor. Sound Transit and others were interested in coordinating for this report because it was a chance to tell their stories, especially because the report garners significant attention. This document is an example of multiple agencies coordinating in a single format, yet communicating individual data. At the same time, this information works well in a coordinated report and provides greater context to the performance results being reported.

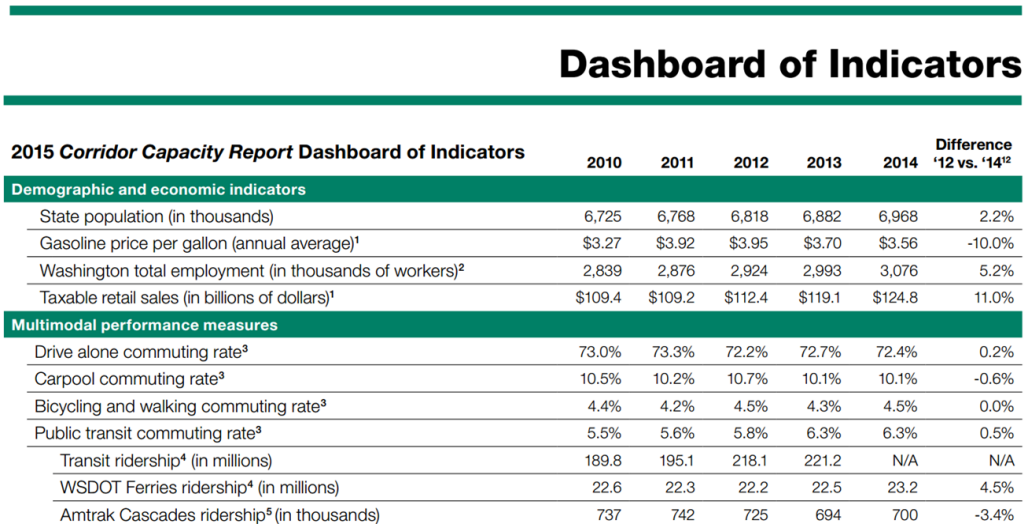
Note how traditional congestion indicators are included along with multimodal performance measures and demographic/economic indicators. Often the public sees congestion as a problem, but in many cases it is an indicator of economic growth as shown in this report. By providing this contextual information, WSDOT is helping the public and partners interpret performance results.

[34] Vital Signs - Greenhouse Gas Emissions. June 2, 2016. http://www.vitalsigns.mtc.ca.gov/greenhouse-gas-emissions

STEP B.2.2	Review and discuss content of reports to ensure consistent messaging

Figure B-13: 2015 WSDOT Corridor Capacity Report

Source: The Gray Notebook Volume 59[35]



Dashboard of Indicators

2015 *Corridor Capacity Report* Dashboard of Indicators	2010	2011	2012	2013	2014	Difference '12 vs. '14[12]
Demographic and economic indicators						
State population (in thousands)	6,725	6,768	6,818	6,882	6,968	2.2%
Gasoline price per gallon (annual average)[1]	$3.27	$3.92	$3.95	$3.70	$3.56	-10.0%
Washington total employment (in thousands of workers)[2]	2,839	2,876	2,924	2,993	3,076	5.2%
Taxable retail sales (in billions of dollars)[1]	$109.4	$109.2	$112.4	$119.1	$124.8	11.0%
Multimodal performance measures						
Drive alone commuting rate[3]	73.0%	73.3%	72.2%	72.7%	72.4%	0.2%
Carpool commuting rate[3]	10.5%	10.2%	10.7%	10.1%	10.1%	-0.6%
Bicycling and walking commuting rate[3]	4.4%	4.2%	4.5%	4.3%	4.5%	0.0%
Public transit commuting rate[3]	5.5%	5.6%	5.8%	6.3%	6.3%	0.5%
Transit ridership[4] (in millions)	189.8	195.1	218.1	221.2	N/A	N/A
WSDOT Ferries ridership[4] (in millions)	22.6	22.3	22.2	22.5	23.2	4.5%
Amtrak Cascades ridership[5] (in thousands)	737	742	725	694	700	-3.4%

Linkages to Other TPM Components

Component 06: Reporting and Communication (See TPM Framework)

STEP B.2.3	Formalize process for monitoring and reporting

Description

Because data collection, management, and software evolve so rapidly, agencies must continually reassess their practices to identify opportunities for collaboration that could leverage partners' capabilities. Staff should meet with partner agency staff to discuss monitoring and reporting activities to identify overlap and then develop a plan to reduce that overlap by working together.

By formally documenting the process for collaboration and coordination, agencies will hold each other accountable for the roles and responsibilities agreed to in the plan. Triggers, in terms of time period or particular event, should be included in such documentation to ensure that continuous reassessment of collaboration is undertaken.

> "We're constantly reevaluating our reports, thinking tactically, strategically, about relevance."
>
> - Daniela Bremmer, WSDOT

Once implemented, any collaborative monitoring and reporting processes should be refined when results do not meet expectations. Avoid scrapping agreements altogether if at first shared responsibility does not work; agencies are used to working separately. Ensure leadership support for collaboration to ensure it is carried through rough spots.

[35] Washington State Department of Transportation. (2015). The Gray Notebook: WSDOT's Quarterly Performance Report on Transportation Systems, Programs, and Department Management (September 30, 2015). Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/Sep15.pdf

STEP B.2.3	Formalize process for monitoring and reporting

Examples

Data Use Agreements: I-95 Corridor Coalition

The I-95 Corridor Coalition is a partnership of transportation agencies and related organizations from Maine to Florida. The Coalition provides these agencies and organizations a forum to discuss transportation issues that cross jurisdictional boundaries.

The Coalition began its Vehicle Probe Project in 2008 to provide members with access to reliable travel time and speed data without hardware and sensors. In 2014, the organization has developed a traffic probe data marketplace to enable members to purchase INRIX, HERE, or TomTom data for their jurisdictions based on individual needs.[36] The Coalition negotiated costs for all members, and once a single member purchases data, that particular data set is available to all members for no additional cost. When purchasing data, a member must complete a Data Use Agreement[37] that extends the Coalition license to that member.

Data are used for incident and traffic monitoring both within and across jurisdictional borders and provides travel times for roadway signs, on websites, and for the 511 system. By collaborating and coordinating on data acquisition, the Coalition has enabled coordinated monitoring and reporting as well.

Tri-State Monitoring and Reporting: Collaboration Across State Boundaries[38]

The transportation agencies of Maine, New Hampshire, and Vermont have been collaboratively reporting since 2011. A memorandum of understanding was signed in 2010 stating the intention to develop common performance measures for the transportation system and agency business practices. Since that time, the state departments have published joint quarterly reports on measures including percent on-time delivery of projects, bridge condition index, and others. This common monitoring and reporting framework expanded upon coordination already taking place to share data across state lines using the Managing Assets for Transportation System, a customized software system for operations tracking and reporting. Collaboration on development and

> "Without a doubt, and with 'no fear', the Tri State members recognize the value in collaborating and comparing similar performance measures."
>
> Source: Tri-State Performance Measures: 2013 Annual Report

> "The close and collaborative monitoring of these measures has identified areas for improvement … and left the three states well positioned to meet the requirements [of MAP-21]."
>
> Source: Tri-State Performance Measures: 2013 Annual Report

[36] I-95 Corridor Coalition. A Traffic Probe Data Marketplace for State Partners Overseen by the I-95 Corridor Coalition and University of Maryland. http://i95coalition.org/wp-content/uploads/2015/02/One_Pager_VPP_VPP_Suite-31dec2014-final2.pdf?dd650d

[37] I-95 Corridor Coalition. Traffic Flow Data Program R009, Agreement for Use of Data. http://i95coalition.org/wp-content/uploads/2015/02/VPPII_DUAv9_signed.pdf?dd650d

[38] Maine DOT, New Hampshire DOT, Vermont AOT. *Tri-State Performance Measures: 2013 Annual Report*. http://vtransengineering.vermont.gov/sites/aot_program_development/files/documents/publications/2013%20Tri-State%20Report.pdf

STEP B.2.3	Formalize process for monitoring and reporting
	maintenance of the system has reduced costs and enabled more robust monitoring and reporting capabilities. Vermont AOT holds the contract with the vendor for the software system, but all three states are equal partners in consultation and decision-making. Often they are able, through biweekly conference calls, to manage and troubleshoot the system without relying on the vendor, significantly reducing costs. In addition to these biweekly calls, the agencies use a SharePoint site to document meetings and facilitate data sharing. Collaborative reporting on common measures has also created a framework for peer learning where staff from the three state agencies progress together.
Linkages to Other TPM Components	Component 05: Monitoring and Adjustment (See TPM Framework) Component 06: Reporting and Communication Component C: Data Management Component D: Data Usability and Analysis

RESOURCES

Resource	Year	Link
TPM Toolbox	2016	www.tpmtools.org
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning	2014	http://www.fhwa.dot.gov/planning/performance_based_planning/mlrtp_guidebook/fhwahep14046.pdf
Integrating Business Processes to Improve Travel Time Reliability	2011	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L01-RR-1.pdf
NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf
NCHRP Report 660: Transportation Performance Management: Insight from Practitioners	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf
PlanWorks	2015	https://fhwaapps.fhwa.dot.gov/planworks/Home
Target Setting Peer Exchange	2014	https://www.planning.dot.gov/Peer/Arizona/scottsdale_6-17-14_FHWA_target_setting.pdf
Communicating Performance	2015	http://communicatingperformance.com/

ACTION PLAN

1. Of the TPM subcomponents discussed in this chapter, which one would you like to work on?

   ❑ B.1 Planning and Programming ❑ B.2 Monitoring and Reporting

2. What aspect of the TPM process listed above do you want to improve?

3. What "steps" discussed in this chapter do you think could help you address the challenge noted above?

Planning and Programming

- ❑ Engage with external stakeholders to establish goals, objectives, and measures
- ❑ Collaboratively establish targets
- ❑ Develop and implement strategies in a collaborative manner

Monitoring and Reporting

- ❑ Implement data sharing protocols
- ❑ Review and discuss content of reports to ensure consistent messaging
- ❑ Formalize process for monitoring and reporting

4. To implement the "step" identified above, what actions are necessary, who will lead the effort and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success and what solutions did this guidebook provide?

6. Who is someone (internal and/or external) I will collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

TABLE INDEX

U.S. Department of Transportation
Federal Highway Administration

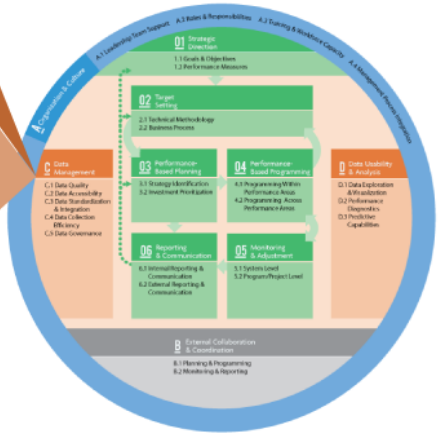
COMPONENT C

DATA MANAGEMENT

This chapter provides assistance to transportation agencies with the "Data Management" component of Transportation Performance Management (TPM). It discusses how data management fits within the TPM Framework, describes how it interrelates with the other nine components, presents definitions for associated terminology, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for data management may differ from what is included in this chapter.

C Data Management

C.1 Data Quality
C.2 Data Accessibility
C.3 Data Standardization & Integration
C.4 Data Collection Efficiency
C.5 Data Governance



Data Management encompasses a set of coordinated activities for maximizing the value of data to an organization. It includes data collection, creation, processing, storage, backup, organization, documentation, protection, integration, dissemination, archiving and disposal. Well-managed data are essential for a robust TPM practice.

INTRODUCTION

Data provide a foundation for TPM, informing decisions about how to best use available resources to maximize transportation system performance. Agencies make substantial investments in data, and seek to obtain the greatest possible return from these investments. Increasingly, agencies are recognizing that data should be managed as a valuable asset, analogous to physical assets like pavement and bridges.[1] The American Association of State Highway and Transportation Officials (AASHTO) Standing Committee on Planning (SCOP) Core Data Principles recognize data as an asset and define how to protect it and maximize its value[2]:

Principle 1 - VALUABLE: Data is an asset—Data is a core business asset that has value and is managed accordingly.
Principle 2 - AVAILABLE: Data is open, accessible, transparent and shared—Access to data is critical to performing duties and functions, data must be open and usable for diverse applications and open to all.
Principle 3 - RELIABLE: Data quality and extent is fit for a variety of applications—Data quality is acceptable and meets the needs for which it is intended.
Principle 4 - AUTHORIZED: Data is secure and compliant with regulations—Data is trustworthy and is safeguarded from unauthorized access, whether malicious, fraudulent or erroneous.
Principle 5 - CLEAR: There is a common vocabulary and data definition—Data dictionaries are developed and metadata established to maximize consistency and transparency of data across systems.
Principle 6 - EFFICIENT: Data is not duplicated—Data is collected once and used many times for many purposes.
Principle 7 - ACCOUNTABLE: Decisions maximize the benefit of data—Timely, relevant, high quality data are essential to maximize the utility of data for decision making.

Data management practices require coordinated agency-wide planning in order to collect, store, and provide data most efficiently and effectively. Although many transportation agencies are "data rich" and "information poor," improved data management practices can enhance their abilities to use the data and become "information rich."

Data management practices are crucial to TPM and can benefit an agency in a variety of ways:

- Improving the accuracy, completeness, consistency, and timeliness of data;
- Providing a "single version of the truth" to use in analyses and reporting;
- Enabling new analysis possibilities through providing more accessible data and data linkages;
- Collecting and sharing data more efficiently across an agency and with agency partners; and
- Fostering a culture that understands and supports the value of data in business processes.

This chapter includes noteworthy practices that can be used to implement and improve data management processes and capabilities within a transportation agency.

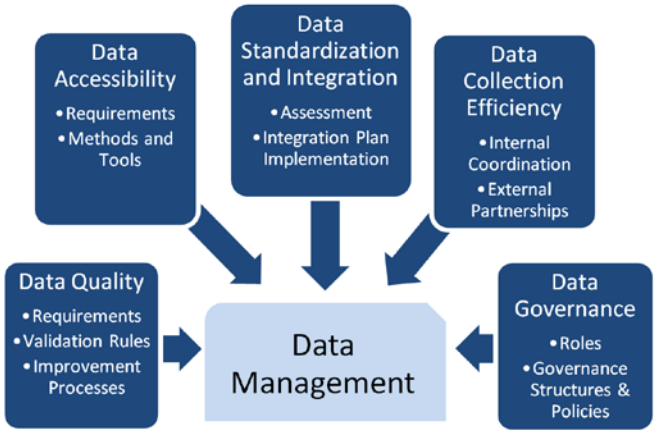
Data management practices can be implemented both at an agency-wide level and within individual business units. For example, a business unit might implement a data quality management process for the data it collects, while an agency might have overarching standards so that data can be integrated and shared across different business units. Each of the components discussed in this chapter can similarly be addressed at different levels within an agency. Some aspects of data management may also involve cross-agency collaboration – for example, to standardize data elements for aggregation and reporting.

[1] NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide. http://www.trb.org/Main/Blurbs/173470.aspx
[2] Data Subcommittee Efforts. Retrieved June 29, 2016. http://planning.transportation.org/Pages/Data.aspx

SUBCOMPONENTS AND IMPLEMENTATION STEPS

Figure C-1: Subcomponents for Data Management

Source: Federal Highway Administration



In this guidebook, Data Management is defined as a set of coordinated activities for maximizing the value of data to an organization. It includes data collection, creation, processing, storage, backup, organization, documentation, protection, integration, dissemination, archiving, and disposal. The data management subcomponents illustrated in Figure C-1 ensure delivery of integrated data of sufficient quality for use in each of the key TPM processes. These specific aspects of data management[3] are important to consider for strengthening TPM:

- **Data Quality:** Processes and organizational functions to ensure data are accurate, complete, timely, consistent with requirements and business rules, and relevant for a given use.
- **Data Accessibility:** Processes and organizational functions to provide access to key data sets.
- **Data Standardization and Integration:** Processes and organizational functions to integrate and compare data sets as needed to support transportation performance management.
- **Data Collection Efficiency:** Efforts to maximize use of limited agency resources through coordination of data collection programs across business units and with partner agencies.
- **Data Governance:** Establishing accountability and decision making authority for collecting, processing, protecting, and delivering data.

It is important to note that these components are interrelated. For example, data governance is the mechanism by which data quality, accessibility, and standardization are achieved. Coordinated data collection supports data standardization. Data standardization and integration efforts facilitate the provision of centralized access to agency data. A comprehensive approach to data management that considers each component and how it can be mutually reinforcing is most effective.

> "One asset that is owned by virtually all transportation agencies – yet often overlooked – is data."
>
> Source: NCHRP Report 814, Data to Support Transportation Agency Business Needs: A Self-Assessment Guide

Each of the components within the TPM framework depends on reliable and consistent performance data:

- Lack of attention to *data quality* can undermine the success of the entire TPM program and lead to loss of credibility for an agency.
- Lack of attention to *data accessibility* can increase the time and effort needed for agency staff to compile and use performance data for monitoring, reporting, and responding to external information requests. It can also impact external perceptions about an agency's degree of transparency and result in missed opportunities to support external collaboration on performance reporting.
- Lack of attention to *data standardization and integration* can impact an agency's ability to develop effective strategies to address multiple performance goals. It can also impact an agency's ability to

[3] Discussion of key data management elements in this chapter draws upon material presented in NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide, Appendix C. http://www.trb.org/Main/Blurbs/173470.aspx

understand the likely impacts of programmed projects and other planned work activities on future performance.

- Lack of attention to *data collection efficiency* can result in missed opportunities for improved resource utilization.
- Lack of attention to *data governance* can make it difficult for an agency to achieve and sustain improvements to data quality, access, integration, and efficiency.

Most agencies already have some data management processes in place. Because of this, the suggested implementation steps listed in Table C-1 will vary by agency. As an agency's data management practices become more mature, benefits will be realized in the form of higher quality data that is accessible and usable across an agency in support of TPM.

Table C-1: Data Management Implementation Steps

Source: Federal Highway Administration

Data Quality	Data Accessibility	Data Standardization and Integration	Data Collection Efficiency	Data Governance
1. Establish data quality requirements and metrics	1. Establish requirements for different audiences	1. Assess data against standards and requirements	1. Identify opportunities for data collaboration	1. Define roles and accountability
2. Create data validation rules	2. Enhance data access methods and tools	2. Create and implement a data integration plan		2. Implement governance structures and policies
3. Develop quality management processes				

CLARIFYING TERMINOLOGY

Table C-2 presents definitions for some of the data management terms used in this guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table C-2: Data Management: Defining Common TPM Terminology

Source: Federal Highway Administration

Common Terms	Definition	Example
Data Accessibility	The ease with which agency staff and partners can obtain data needed for transportation performance management.	One State DOT has three different traffic operations centers that monitor real-time travel conditions. However, there are no procedures or systems in place to consolidate data across the centers or summarize it in a useful form for reporting.
Data Availability	The degree to which data needed for TPM exist at the right level of detail, with sufficient coverage to meet information needs.	Lack of supply chain data may limit a freight planner's ability to evaluate the effectiveness of alternative strategies for freight mobility improvement.

Common Terms	Definition	Example
Data Change Management	Processes to coordinate and communicate changes to data definitions, data structures and associated information systems. Change management processes are aimed at minimizing impacts to users and reducing change-related errors.	A change to the definition of bridge elements requires evaluation to determine and plan for impacts on performance of inspections, calculation of bridge condition indices, identification of rehabilitation strategies, and data structures and software supporting bridge inspection and management processes.
Data Governance	Establishment of decision rights and accountability with respect to data. For example, who is accountable for data quality and how decisions about sharing data, investing in new data, or improving existing data are made.	A State DOT's information governance body defined a set of data policies that emphasize data as a shared agency asset and designated data stewards with responsibility for each category of data.
Data Integration	Combining data that reside in different locations to present a unified view. Data may be integrated into a single physical repository. Alternatively, data may be integrated "virtually" without creation of a new physical data repository.	The DOT established a data warehouse to provide an integrated view of capital projects, including current status, assets, funding sources, and costs to date.
Data Quality	The degree to which data are suitable for a given use, considering consistency with requirements and established business rules, accuracy, completeness, and currency or timeliness.	Lack of timely crash data challenges a safety planner's ability to address emerging safety issues.
Data Standardization	Practices to ensure different data sets adhere to established standards–which may pertain to inclusion of certain attributes, the definition and meaning of data attributes, their specific format, measurement or quality specifications, allowable values, etc.	Use of a standard linear referencing system (LRS) enables an agency to display data about traffic, crashes, and various highway features on the same map.
Data Validation	Process that uses specified criteria to determine whether data are correct, complete and meaningful.	Validation routines are run on pavement condition data to check for out-of-range condition measures and distresses that are not compatible with the recorded pavement type.
Source System of Record	The designated authoritative source system for a given type of data. A single source system is designated to avoid a situation in which multiple versions of a data set are being updated independently and not kept in sync.	The agency's traffic monitoring system is the source system of record for annual average daily traffic (AADT) data.

Common Terms	Definition	Example
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.

RELATIONSHIP TO TPM COMPONENTS

The ten TPM components are interconnected and in many cases dependent on each other. Table C-3 summarizes how each of the nine other components relate to the data management component.

Table C-3: Data Management Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to Data Management
01. Strategic Direction	The establishment of an agency's focus through well-defined goals/objectives and a set of aligned performance measures.	Data management processes must be responsive to an agency's business needs, as established by the strategic direction.
02. Target Setting	The use of baseline data, information on possible strategies, resource constraints, and forecasting tools to collaboratively set targets.	Target setting establishes data quality, access, and integration requirements to be addressed in data management processes.
03. Performance-Based Planning	Use of a strategic direction to drive development and documentation of agency strategies and priorities in the long-range transportation plan and other plans.	Performance-Based Planning establishes data quality, access and integration requirements to be addressed in data management processes. It relies on data managed from multiple internal and external sources, and therefore benefits from a coordinated data collection strategy.
04. Performance-Based Programming	Allocation of resources to projects to achieve strategic goals, objectives and performance targets. Clear linkages established between investments made and their expected performance outputs and outcomes.	Performance-Based Programming establishes data quality, access, and integration requirements to be addressed in data management processes. It relies on data managed from multiple internal and external sources, and therefore benefits from a coordinated data collection strategy.
05. Monitoring and Adjustment	Processes to monitor and assess actions taken and outcomes achieved. Establishes a feedback loop to adjust programming, planning, and benchmarking/ decisions. Provides key insight into the efficacy of investments.	Data management processes directly support Monitoring and Adjustment, which depends on availability of timely, accurate, and authoritative data.
06. Reporting and Communication	Products, techniques, and processes to communicate performance information to different audiences for maximum impact.	Data management processes ensure that data are produced in an efficient and reliable manner.

Component	Summary Definition	Relationship to Data Management
A. TPM Organization and Culture	Institutionalization of a TPM culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support TPM.	Strong data management functions depend on an organizational culture that values data-driven decision making and understands the commitment required to create and sustain quality data.
B. External Collaboration and Coordination	Established processes to collaborate and coordinate with agency partners and stakeholders on planning/ visioning, target setting, programming, data sharing, and reporting.	Sharing data with agency partners is a key element of External Collaboration. Data sharing strengthens transparency and accountability and maximizes use of available resources for data gathering and management across agencies.
D. Data Usability and Analysis	Existence of useful and valuable data sets and analysis capabilities, provided in usable, convenient forms to support TPM.	Sound data management practices ensure availability, quality and integrity of data for visualization, analysis and prediction.

IMPLEMENTATION STEPS

C.1 DATA QUALITY

Enhancing data quality processes can provide an agency with more accurate, complete, consistent, and timely data. Improving data quality improves the credibility and value of data analyses and in turn decision making based on these data. The following section outlines steps agencies can follow to implement a sustainable data quality management program.

1. Establish data quality requirements and metrics
2. Create data validation rules
3. Develop quality management processes

> "Data is needed to create information, which is used by knowledge workers to do their jobs. The right knowledge used by the right worker can turn into wisdom. Without quality data, information and knowledge are suspect and wisdom is unattainable."
>
> Source: Minnesota Department of Transportation, Data Business Plan.

STEP C.1.1	Establish data quality requirements and metrics
Description	Data quality is assessed with respect to a particular set of business needs. Data considered adequate for reporting on system-wide performance may not be sufficient for impact assessment. While agencies generally seek to collect data once and use it multiple times for different purposes, it should be recognized that this means the data must meet quality requirements of the most demanding business use. Analyzing the cost to achieve the various quality standards and the associated business value is critical. Once the business purpose(s) for data have been identified, quality requirements can be defined. The table below includes a set of data quality characteristics that can be used to consider requirements and develop quality metrics. • **Data accuracy** refers to the match between the data and real-world conditions. Assessing data accuracy frequently requires defining a set of validation rules for a data set, as well as measuring the number of errors (records not meeting the rules) and establishing a maximum acceptable error rate. However, this accuracy assessment method can miss many errors, i.e., data may be in acceptable ranges but still not be correct. Therefore, independent verification processes are needed to gain a true measure of accuracy. These may involve an independent re-collection of data for a sample of records, or cross checks against an independent source (if available). An accuracy metric can be established based on the percent of independently verified records that match the original record. • **Data completeness** refers to the extent to which a data set provides the intended (or required) degree of coverage and whether it includes values for attributes that are considered essential for a particular business purpose. For some types of data, the assessment of coverage is straightforward. For example, one can determine the percentage of National Highway System (NHS) mileage covered by a pavement data set. For other types of data, the assessment of coverage can be more challenging. For example, it is not easy to tell whether a crash data set contains all crashes that occurred that meet established reporting criteria. • **Data consistency** refers both to consistency of records *within* a data set and *across* data sets that have been independently collected. Internal inconsistencies may result from lack of standard data collection processes. For example, there may be inconsistencies across bridge inspection records within a data set due to insufficient inspector training, leading to varying interpretations of attributes. Inconsistencies

STEP C.1.1	Establish data quality requirements and metrics

across data sets may be due to use of different methods or data definitions. In another example, pavement condition data for the state highway network may have been collected using automated crack detection methods, whereas a local pavement condition data set may have been based on visual crack observations. This inconsistency could make it difficult to create a consolidated report on pavement condition on the NHS. Another common issue related to data consistency is changes to attribute definitions or measurement methods over time. Lack of consistency in attributes, attribute definitions, and collection methods can pose barriers to use of data for baseline development, trend analysis and benchmarking. Consistency can be assessed and improved by developing and documenting clear data standards, covering definitions, measurement methods, formats, and valid value ranges.

- **Data timeliness** refers to the amount of time that it takes from collection of the data to making the data available for use. Timeliness can be improved through automation, ensuring sufficient staff resources to perform collection and processing tasks, and streamlining of review and approval processes (within and across agencies). There may be practical constraints on resources for data collection, quality assurance and processing activities that limit timeliness improvement. Data currency is a related concept that represents the extent to which a data set represents current conditions. For example, a requirement for data currency might be that all bridge condition records reflect inspections completed within the last two years.

Table C-4: Quality Data Characteristics

Source: Federal Highway Administration

Characteristic	Measurement Considerations
Data accuracy	• Values within acceptable ranges • Internal consistency across attributes • Independent verification
Data completeness	• Full coverage of intended scope • Values present for required elements
Data consistency	• Consistency of measurement methods and data definitions • Consistency of data structures • Standardization of data types and coding methods
Data timeliness/data currency	• Lag between data collection and availability • Meeting user needs for current information

Defining data quality requirements and metrics involves tradeoffs. For example, an agency may decide to release data that is 80% accurate – based on a realization that getting data to near 100% accuracy would require so much time and effort that the data would no longer be valuable by the time it was released. High quality data requires investments in the data itself, and in processes to measure, track and address data quality. An independent verification process can be essential to ensure data accuracy, but requires additional effort beyond the primary data collection. Some agencies choose to view the cost of quality assurance as an integral part of the base data collection cost.

STEP C.1.1	Establish data quality requirements and metrics

Examples

Crash Data Improvement Program Guide: Federal Highway Administration[4]

FHWA developed the Crash Data Improvement Program (CDIP) Guide to "assist state crash database managers and other traffic safety professionals in identifying, defining and measuring the characteristics of the data quality within the state crash database." The CDIP Guide focuses on crash data timeliness, accuracy, completeness, consistency, integration, and accessibility. For each of these elements of data quality, the Guide provides ways to develop a metric and assess performance, and provides examples of metrics.

Examples for each are provided below:

- **Timeliness:** Average reporting days (number of days between crash occurrence and database entry)
- **Accuracy:** Average number of errors per crash report
- **Completeness:** Percent of crashes located (i.e., placed at a specific point on the road system)
- **Consistency:** Percentage of local agencies using the statewide standard crash report form
- **Integration:** Number of agencies locating safety events using a specified tool (enabling linkages between crash and roadway files)
- **Accessibility:** Percent of local agencies using the online crash data system for data retrieval and reporting

Figure C-2: Crash Reporting Data Aggregation

Source: Federal Highway Administration

Agency Name	2006 Crashes	Average Reporting Days
Huntington Woods Police Dept	42	12.58
Keego Harbor Police Dept	28	29.36
Kensington Metro Park Police Dept	5	10.99
Lake Angelus Police Dept	0	0
Lake Orion Police Dept	39	43.25
Lathrup Village Police Dept	147	19.24
Madison Heights Police Dept	444	11.38
Milford Police Dept	159	10.1
Novi Police Dept	515	11.93
Oak Park Police Dept	265	13.85
Orchard Lake Police Dept	77	11.5
Oxford Police Dept	28	26.11
Pleasant Ridge Police Dept	56	24.9
Pontiac Police Dept	765	26.72
Rochester Police Dept	107	15.98
Royal Oak Police Dept	481	15.11
Royal Oak Twp Police Dept	0	0
South Lyon Police Dept	48	10.23
Southfield Police Dept	1083	25.18

Summary of Output

Statewide Total Crashes	**121,787**	
Statewide Average Reporting Days (Database Load - Crash Date)		**19.65**

Linkages to Other Component 02: Target Setting (See TPM Framework)

[4] Federal Highway Administration, Crash Data Improvement Program Guide (April 2010). http://safety.fhwa.dot.gov/cdip/finalrpt04122010/finalrpt04122010.pdf

STEP C.1.1	Establish data quality requirements and metrics
TPM Components	Component 05: Monitoring and Adjustment Component 06: Reporting and Communication Component D: Data Usability and Analysis Capabilities

STEP C.1.2	Create data validation rules
Description	Data validation rules can be established to assess accuracy, consistency, and completeness. Data validation rules are best established through a collaborative effort between subject matter experts with an understanding of the data and data uses, and data managers who understand how to translate the rules into precise language required for automation. **Rules can be defined to specify:** • Valid ranges for numeric attributes • Valid lists of values for coded attributes • Invalid combinations of attribute values (e.g., a flexible pavement cannot have faulting) • Conditions under which null values are acceptable for different attributes • Acceptable changes from an earlier observation (e.g., an improvement in bridge condition without an intervening maintenance or rehabilitation action) • Comparison of aggregate quantities for a data set to a standard (e.g., record count matches expectation; mileage sums to an appropriate value given the expected data set coverage) Data quality checks are best implemented as part of a data collection or data entry process so that problems can be detected and corrected early on. Where this is not practical, validation rules can be applied to existing data sets. This can be accomplished as a series of queries, or implemented via data profiling and cleansing software. Manual review of data can be helpful to elicit ideas and suggestions for validation. An iterative approach can be taken involving implementation of basic validation rules and then manual review to refine the existing rules and identify additional rules.
Examples	**Quality Analysis Software: Virginia Department of Transportation[5]** Virginia DOT (VDOT) uses over 95 rules to validate data as part of its Traffic Monitoring System Raw Data Error Review Process. Automatic review software uses these rules and data comparisons, and assigns quality ratings to the data along with advisory messages. These ratings and messages can then be reviewed manually, and updated where appropriate. The table below describes the icons used to depict four levels of message urgency for quick recognition. VDOT started using the software around 1998-1999, and has refined the process over time. The agency adds new tests to the review process when staff analyzes the data or

[5] Federal Highway Administration, Traffic Monitoring Guide – Appendix E: Compendium of Data Quality Control Criteria (September 2013). http://www.fhwa.dot.gov/policyinformation/tmguide/tmg_fhwa_pl_13_015.pdf

STEP C.1.2	Create data validation rules

troubleshoots hardware and equipment issues. The agency has found value in new calculated data comparison. VDOT has also developed an automated review process to review specific data instead of the full data to avoid meaningless review results. Several years ago VDOT color-coded the date selection calendar in order to provide users and managers with a quick indication of data existence, review status, and the health of the data collection.

Table C-5: VDOT Quality Analysis Alert System

Source: Federal Highway Administration[6]

Icon Level	Icon Description	Icon Meaning
1	A question mark in a green circle.	An advisory of a questionable nature.
2	A lowercase letter I in a blue circle.	An informational advisory.
3	An exclamation mark in a yellow triangle.	A warning level message.
4	An X in a red circle.	An error level message.

Linkages to Other TPM Components

Component 05: Monitoring and Adjustment (See TPM Framework)

Component D: Data Usability and Analysis Capabilities

STEP C.1.3	Develop quality management processes

Description

Data quality management is an ongoing process for ensuring that data meet established quality requirements. Continually improving data quality can increase data value, leading to improved decision-making at an agency. Developing quality management processes can help ensure that data quality remains an ongoing priority after initial data acquisition efforts.

Establishing a data quality management process involves:

- Documenting data quality requirements and their business justification
- Defining steps that will be taken to assess agency data to determine whether the data meet data quality requirements
- Defining steps that will be taken to improve quality of both existing data and of new data that the agency will acquire in the future
- Establishing roles, responsibilities and deliverables for each step
- Developing a calendar of data quality activities
- Budgeting for sufficient staff time and contractor resources to accomplish each step
- Obtaining feedback on data quality processes and using this feedback to improve efficiency and effectiveness

Specific activities to consider for inclusion in a performance data quality management plan include:

- Data collection staff training
- Data collection equipment specification and calibration

[6] Federal Highway Administration, Traffic Monitoring Guide – Appendix E: Compendium of Data Quality Control Criteria (September 2013). http://www.fhwa.dot.gov/policyinformation/tmguide/tmg_fhwa_pl_13_015.pdf

STEP C.1.3	Develop quality management processes
	• Certification processes for both staff and equipment • Continuous data quality audits • Independent validation processes • Acceptance criteria for new data sets (incorporated into data collection contracts where appropriate) • Modification of data entry applications to build in lists of values and data validation rules. • Automation of data validation and cleansing processes • Provision of mechanisms for data users to report errors • Use of supplemental data sets to fill in gaps in the primary source (e.g., blending of travel time data from different sources) • Creation of applications that facilitate quality review, e.g., review of historical data at a location, or review of tabular data against imagery or other data sources for a location
Examples	**Guide to Quality Management Processes for Pavement Condition Data: Federal Highway Administration[7]** FHWA developed the "Practical Guide for Quality Management of Pavement Condition Data Collection" in 2013. The report includes a quality management cycle for pavement data. The cycle involves six steps and includes feedback, with continual data evaluation and process evaluation. **Figure C-3: FHWA Pavement Condition Data Quality Process** Source: NCHRP Report 814[8] 

[7] Federal Highway Administration, "Practical Guide for Quality Management of Pavement Condition Data Collection" (February 2013). http://www.fhwa.dot.gov/pavement/management/qm/data_qm_guide.pdf

[8] Federal Highway Administration. (2013). Practical Guide for Quality Management of Pavement Data Collection. Washington, DC. http://www.fhwa.dot.gov/pavement/management/qm/data_qm_guide.pdf

STEP C.1.3	Develop quality management processes
	Michigan Department of Transportation's Intermodal Management System Michigan DOT Intermodal Management System (IMS) business processes define data needs and accuracy, completeness, and timeliness requirements. The system includes 54 categories of data that are assessed quarterly for quality and completeness. Quarterly data quality reports include information on data currency (update due versus actual), known flaws (e.g., missing data), and importance (e.g., used to meet reporting requirements). Data quality categories are assigned as follows on the reports: • Green: Data are complete, correct and capable of supporting business processes • Yellow: Data are incomplete or incorrect and could pose problems supporting business processes • Red: Data are incomplete or incorrect and currently incapable of supporting business processes[9]
Linkages to Other TPM Components	Component 05: Monitoring and Adjustment (See TPM Framework) Component 06: Reporting and Communication Component A: Organization and Culture Component D: Data Usability and Analysis Capabilities

[9] NCHRP Report 814 - Data to Support Transportation Agency Business Needs: A Self-Assessment Guide (November, 2015). http://www.trb.org/Main/Blurbs/173470.aspx

C.2 DATA ACCESSIBILITY

To provide value for decision making, data must be available in useful forms to different audiences. Potential users need to know what data exist and how to obtain them, and understand their derivation and limitations. Ideally, information about available data and points of access for data will be consolidated within an agency to make it easier for staff to discover and use data. Ensuring accessibility to external data sources and, conversely, providing external access to agency data (where feasible and appropriate), can facilitate collaboration in performance-based planning and programming by providing a common view of historical, current and (where available) forecasted performance conditions. The following section outlines steps agencies can follow to ensure good access to data in support of transportation performance management.

> "Findability Precedes Usability
> In the Alphabet and on the Web
> You Can't Use What You Can't Find."
> - Peter Morville, "Ambient Findability" (2005)

1. Establish requirements for different audiences
2. Enhance data access methods and tools

STEP C.2.1	Establish requirements for different audiences
Description	Improving accessibility of performance data begins with an analysis of requirements: who needs to see performance data – for what purpose, and in what form? One way to approach this is to develop a set of information use scenarios. Each scenario would define the type of user (e.g., performance analyst, senior agency manager, elected official), the type of TPM activity they are engaged in (e.g., target setting, strategy evaluation, reporting), what their specific information needs are for this activity, and how they would want to access this information. (Refer to the list of questions included in section 12.2.1 for typical transportation performance management information needs and analysis capabilities.) Once a set of representative performance data use scenarios are assembled, a broader picture of data access requirements will emerge.

Figure C-4: Accounting for Various Audiences
Source: Federal Highway Administration

The following questions should be considered based on the information use scenarios:

- What data need to be accessible to external partners and what data are primarily of interest to internal agency users?
- Which types of users need to see data primarily in summary form?
- Which types of users need to have access to full data sets for detailed exploration?
- Are there standard views or reports that would address the primary needs of particular audiences?
- Which types of users have specialized analysis needs that require integration of performance data into analytical tools?

STEP C.2.1	Establish requirements for different audiences
	It is also important to consider how to ensure that data are sufficiently documented so that users will understand their limitations. Different audiences will require different levels and types of documentation. For example, a data analyst may want highly detailed information about a data set's derivation, whereas a senior manager would prefer to see a few clearly marked essential highlights that facilitate their interpretation and use of the data.

Examples

Table C-6: Data Access Requirements by Activity/User Type

Source: Federal Highway Administration

Activity/User Type	Data Access Requirement
Performance-based planning/data analyst	• Raw data files • Detailed data documentation • Data query/summarization tools • Import and export processes for specialized modeling software
Safety program development/ Program Manager	• Summary statistics • Spatial presentation of data • Summary of data sources and limitations
Program delivery monitoring/ District Administrator	• Dashboard view with drilldown capability • Identification of data sources integrated with charts
External performance reporting/ Communications Officer	• Flexible reporting environment – mix of standard and custom reporting capabilities • Data sources and derivations at both detailed level and at general level (understandable to the lay-person)

Linkages to Other TPM Components

Component 05: Monitoring and Adjustment (See TPM Framework)

Component 06: Reporting and Communication

Component A: Organization and Culture

Component B: External Collaboration

Component D: Data Usability and Analysis Capabilities

STEP C.2.2	Enhance data access methods and tools
Description	Once requirements are established for data access, the agency can assess its existing data access and reporting tools, identify gaps, and plan improvements. Some improvements can be implemented within specific business units; others are more appropriate to pursue at the agency-wide level. For example, a safety analysis unit may implement specialized tools for data access and analysis, whereas an effort to build or enhance a data warehouse and business intelligence environment would typically be an agency-wide initiative. An agency-wide approach—if well planned and designed—can cost-effectively address multiple business needs with a single set of solutions.

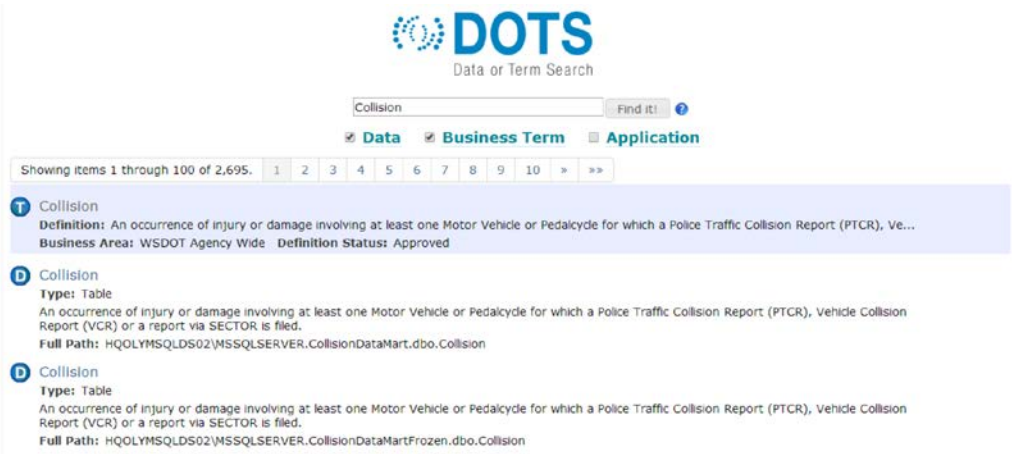
STEP C.2.2	Enhance data access methods and tools
	The following data access methods and tools can be considered for implementation or enhancement: • Make data set available for download on internal or external portal • Make data available via an Application Programming Interface (API) • Make spatial data layers available for display on geographic information system (GIS) portal • Create custom fixed or interactive maps to support specific functions • Create data mart or data "universe" for reporting – with standard reports/charts and ad-hoc reporting/charting capabilities • Create dashboard(s) tailored to needs of different users • Create mobile applications for display of location-aware data **When planning enhancements to data access methods and tools, there are several things to keep in mind:** • Making Data Findable – Data need not all be stored or accessed from the same place, but information about the data can be centralized to make it easy for people to find. Consider implementing a central data catalog to provide a single place to find what data sets are available and how to access them. • Maintaining Data in Authoritative Sources – New data repositories may be created to support reporting – with integrated or transformed data. It is good practice to make sure that these repositories are used for reporting only – rather than as a secondary location for data updating. When data errors are discovered it may be easier to correct these errors directly in the repository that is used for reporting, but this creates extra work in the long term. Errors should be corrected in source systems. • Document and Automate Data Loading - A repeatable and disciplined approach to data transformation and loading from authoritative source data systems to reporting repositories should be followed. Extract-Transform-Load (ETL) tools are available for defining and automating data transformation rules. • Managing Data Access – Clear access policies should be established to protect sensitive data and to explicitly identify what data should be made available outside of the agency. There is a balance between maintaining confidentiality and enriching availability – policies to address this are necessary, as is oversight and an understanding of who has authority to grant access. • Managing Metadata – Data users will want to understand the source(s) and derivation of data sets and the meaning of different data elements. It is important to have a strategy for creating, updating and delivering metadata at both the data set and data element level. As noted above, different types of audiences will want to see metadata at different levels of detail.
Examples	**Data Catalog: Washington State Department of Transportation**[10,11] Washington State DOT developed the Data or Term Search (DOTS) application to create a common data vocabulary across the agency. DOTS describe the database schema, data definitions, and the business stewards – it answers the "What? Where? Who?" questions about the data by describing what data are available, where data are available, and who to go to with questions.

[10] NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide (November 2015).
[11] Everett, Andy. "The Redesigned WSDOT Data Catalog" (April 10, 2014). http://ntl.bts.gov/networking/tlrarchive/201404/201404.pdf

STEP C.2.2	Enhance data access methods and tools

Figure C-5: DOTS Application Screenshot

Source: The Redesigned WSDOT Data Catalog [12]



Data Catalog: Minnesota Department of Transportation[13]

Minnesota DOT implemented a data catalog developed by data stewards designated to specific business domains throughout the DOT. The data stewards identified and documented data items within their domains. The documentation included data terms and metadata (approved term name, term definition, source of record, data classification, and responsible data steward). This information was included in the Business Data Catalog, which staff can use. Cited benefits of the Business Data Catalog include helping to prevent data redundancy and to identify opportunities for reuse.

Data Accessibility Approach: Utah Department of Transportation[14]

Utah DOT has a three-prong approach to making data findable for agency employees and the public. First, the UDOT Data Portal provides access to news, training, applications, and both spatial and non-spatial UDOT data. Second, UDOT Open Data provides a clearinghouse for UDOT's public data, where users can browse by category (e.g., assets, maintenance, planning, projects, etc.). Third, UPlan serves as UDOT's map center, where users can search existing maps or create their own.

Linkages to Other TPM Components

Component 05: Monitoring and Adjustment (See TPM Framework)

Component 06: Reporting and Communication

Component A: Organization and Culture

Component B: External Collaboration

Component D: Data Usability and Analysis Capabilities

[12] Washington State Department of Transportation. (10 April 2014). The Redesigned WSDOT Data Catalog. Olympia, WA. http://ntl.bts.gov/networking/tlrarchive/201404/201404.pdf

[13] NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide (November 2015). http://www.trb.org/Main/Blurbs/173470.aspx

[14] UDOT Open Data (http://udot.uplan.opendata.arcgis.com/), UDOT Data Portal (https://maps.udot.utah.gov/ugate/f?p=111:2:0::NO:::), UPlan (http://uplan.maps.arcgis.com/home/index.html).

C.3 DATA STANDARDIZATION AND INTEGRATION

> "The wonderful thing about standards is that there are so many of them to choose from."
>
> - Grace Hopper, Computer Scientist

TPM activities typically require use of multiple data sets from different sources. For example, in order to understand the relationship between incidents and congestion patterns, the analyst might use data from an incident reporting system together with travel time or speed data. To facilitate analysis, the two data sources should use compatible location references and units of time. Data standardization is also critical for presenting an integrated view of performance across jurisdictions and modes. Collaboration efforts across agencies on performance monitoring and reporting will need to include early discussion of standards for performance measures (see External Collaboration, Component B). Advance planning is important to ensure data standardization; once data are acquired, it may be difficult or impossible to transform it into a standard form.

This subcomponent discusses ways to strengthen organizational capabilities for data standardization and integration.

1. Assess data against standards and requirements
2. Create and implement a data integration plan

STEP C.3.1	Assess data against standards and requirements
Description	A good starting point for data standardization and integration is to conduct a needs analysis. This can involve a systematic review of analysis requirements, identification of data sources that need to be integrated for this analysis, and finally, identification and prioritization of data integration issues. **Common data integration issues include:** • Data entities that are defined in different ways (e.g., different jurisdictions have different definitions of serious injury crashes) • Data entities that do not have the same attributes (e.g., two districts collect data about their culverts, but use different classification and condition rating methods) • Data for related entities cannot be joined because they don't use consistent link fields (e.g., maintenance work is recorded by highway system and shed identifier; construction work is recorded by project ID) A variation on the third case above is use of different coding systems for a given attribute. For example, there may be different systems for locating an asset or activity along a road (e.g., construction stationing versus intersection-offset versus milepost). Data standards are especially important to define for spatial and temporal referencing. These two dimensions provide the foundation for looking at patterns and relationships across data sets (e.g., truck traffic and pavement condition, weather and crashes, etc.) Where standards or "master" sources of values for these items exist, the needs assessment can determine which data sets are in compliance with these standards. Where standards do not exist, current variations in classifications and referencing methods can be reviewed to provide input into possible establishment of standards. In some cases, crosswalks or mappings can be established across different coding or classification systems. For example, in many states, a county identifier can be used to derive the district or region.

STEP C.3.1	Assess data against standards and requirements

Examples

The table lists commonly used data references that, when used inconsistently across data sets, can impact the agency's capabilities as described in the second column.

Table C-7: Data Linkages and Descriptions

Source: Federal Highway Administration

Data Linkage	Description
Spatial: Linear Referencing	• Impacts ability to integrate data along a route • Consistency is necessary for spatial overlay and combination of multiple data sets using different segmentations • Changes in linear referencing as road networks are modified impact ability to integrate historical and current data unless referencing is kept "in sync"
Spatial: Coordinate Referencing	• Impacts ability to combine multiple data sets in a spatial viev • Use of differing projections and accuracy levels can create issues
Spatial: Zone Systems	• Impacts ability to integrate data based on defined geographi areas (e.g., counties, districts, traffic analysis zones)
Asset Identification	• Impacts ability to integrate different data pertaining to an asset (e.g., condition, maintenance history, planned work for a given bridge)
Project Identification	• Impacts ability to integrate different data pertaining to a particular project (e.g., cost, scope, status, funding) • Multiple identification systems may be in place for different stages of the project life cycle
Work or Expenditure Category	• Impacts the ability to integrate data from different sources about planned or historical expenditures to improve performance

Linkages to Other TPM Components

Component 05: Monitoring and Adjustment (See TPM Framework)

Component 06: Reporting and Communication

Component A: Organization and Culture

Component B: External Collaboration

Component D: Data Usability and Analysis Capabilities

STEP C.3.2	Create and implement a data integration plan

Description

Based on the needs assessment, a prioritized data integration plan can be established – considering both what types of integration will have the most impact, and which are easiest to tackle.

The data integration plan should consider the following strategies:

- Adoption of agency data standards – these may be national standards (e.g., the Model Inventory of Road Elements or MIRE) or agency-specific standards. Standards

STEP C.3.2	Create and implement a data integration plan

provide a common reference for defining data entities and their attributes. As noted above, standards for location referencing are important to include.

- Formal designation of the single authoritative "source system" for each type of data to be integrated.
- Developing and maintaining a high level agency-wide data model that shows integration points between major types of data entities.
- Creation of boilerplate requirements language to ensure that new applications adhere to the agency's data standards.
- Centralized management of common code lists – with processes to keep these in sync across disparate applications.
- Data and application modification – to make existing databases and supporting applications conform to standards. These modifications may be relatively straightforward or more complex, depending on the nature of the application.
- Data conversion or mapping services – development of standard conversion routines (e.g., to assign a district given a county, assign a timestamped event to a fiscal year or convert a linear reference to an X,Y coordinate).
- Creation or expansion of data warehouses that use Extract-Transform-Load functions to pull data from multiple sources and perform necessary conversions to get data in a standardized form.
- Development of reports that pull data from different sources and perform necessary linkages and conversions on demand.
- A change management strategy that includes processes to ensure that when data structures are modified in source systems, dependent systems and reports don't break. Metadata repository tools can be helpful here – as they can maintain information about which attributes are included in different data tables.

An advantage of developing a data integration plan is to identify common integration needs that can be addressed through standardized solutions – rather than as a series of independent projects to meet needs as they arise. This may require up-front effort but will save time in the long run and will lead to greater consistency and a reduced data maintenance burden.

It is important to keep in mind that adopting a data standard and making sure that current (and future) data sets comply with the standard are two distinct activities. There can be both technical and organizational barriers to data standardization that should be recognized during the process of standards development and adoption. Assigning the right people with the right skill sets for supporting and enforcing standards implementation is essential to success. Both technical skills related to data architecture and organizational skills are needed. In addition, agencies should schedule a regular process of monitoring plan implementation and modification as needed based on progress made, new opportunities, and changes in priorities.

STEP C.3.2	Create and implement a data integration plan

Examples

Standardized Linear Referencing System: Idaho Transportation Department[15,16,17]

The Idaho Transportation Department (ITD) now uses a commercial linear referencing system product to synchronize location information across separate systems that manage bridge, safety, and traffic data. Prior to the implementation of the commercial system, ITD had used the MilePoint and Coded Segment (MACS) LRS, a mainframe-based attribute system. Implementation of the commercial system resulted in reduced high mainframe maintenance costs, automated event location stability, and the elimination of "data integration by memo" so that changes to the LRS are automatically reflected throughout the system. To integrate the data, ITD created new data standards and data maintenance rules in order to resolve temporal issues. The new data standards and maintenance rules enabled ITD to provide capabilities to correct temporal mistakes and convert temporal events.

Centerline Data Standard: Oregon Department of Transportation[18]

Oregon DOT has developed a statewide Road Centerline Data Standard, with the goals to:

- Ensure the compatibility of data sets within the same framework feature set and between other framework feature sets and themes;
- Assist agencies responsible for the creation, maintenance, and distribution of road centerline data sets by reducing the costs of data sharing, data development, and data maintenance between road authorities; and
- Ensure that road centerline attribution (including geometry) is as up-to-date, complete, and accurate as possible by relying on local road authorities' expertise and data quality mandates

Work on the data standard began in 2004, and Oregon DOT adopted the standard in 2006, with only minor changes since then. The data standard describes the elements and data structure necessary to adequately describe, produce, and use road centerline data produced in Oregon. It does this through a core set of geospatial information and geometry to support the need for an accurate and current representation of Oregon's traveled road infrastructure.

Initial applications of the road centerline data include route-milepost and address range methods of linear referencing, and digital interaction between the road centerline data set and the hydrography data set(s). Future applications could include network connectivity solutions to support oversize vehicle routing, emergency response, and planning for intelligent transportation system deployments.

[15] NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide (November 2015). http://www.trb.org/Main/Blurbs/173470.aspx

[16] Phil Hardy and Brian Emmen, "LRS Maintenance at Idaho Transportation Department" http://www.gis-t.org/files/ybDsW.pdf.

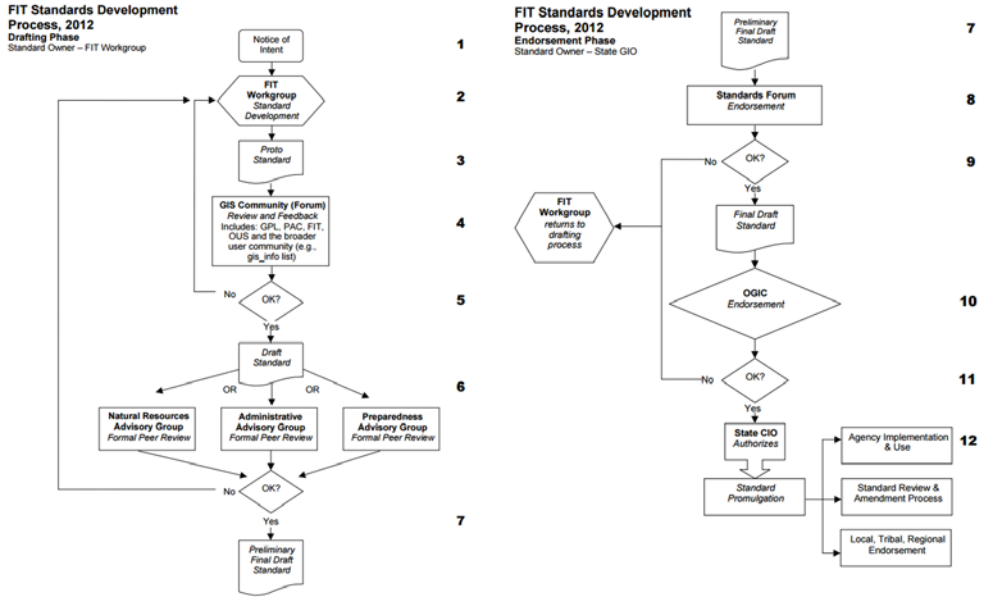
[17] Cambridge Systematics, "Market Research for Idaho Transportation Department Linear Referencing System (LRS)," Idaho Transportation Department Research Report (August 31, 2009), https://itd.idaho.gov/highways/research/archived/reports/RP198%20-%20Final%20LRS%20Report%20with%20ITD%20Cover.pdf.

[18] Oregon Department of Transportation, Oregon Road Centerline Data Standard, Version 6.0 (November 2014). http://www.oregon.gov/DAS/CIO/GEO/fit/transportation/docs/TransStandardVersion_6_0.pdf

STEP C.3.2	Create and implement a data integration plan

Figure C-6: Oregon DOT Centerline Data Standard

Source: Oregon Geospatial Enterprise Office[19]



Linkages to Other TPM Components	Component B: External Collaboration (See TPM Framework)
	Component D: Data Usability and Analysis Capabilities

[19] Oregon Geospatial Enterprise Office. (2012). Oregon Geospatial Standards Development Guidelines. Salem, OR. https://www.oregon.gov/geo/standards/FIT%20Standard%20Development%20Process,%20v.1.1.pdf

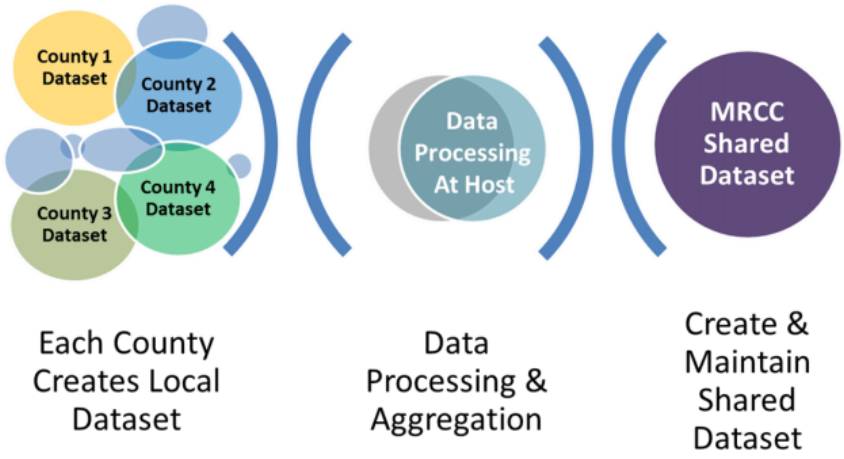
C.4 DATA COLLECTION EFFICIENCY

Assembling a complete and useful picture of performance levels and causal factors requires a large and complex body of data. Collecting, managing and processing data to support transportation performance management requires significant expenditures – both in terms of direct data collection expense and agency staff time. In some cases, multi-agency collaboration is necessary – for example, assembling performance data for all National Highway System facilities, or for a multi-state corridor. Active planning and coordination both within agencies and across agencies is required to ensure that data collection is pursued in an efficient and coordinated fashion. This subcomponent will assist agencies in efficiently collecting useful data for transportation performance management.

> "As I discussed what was possible with maintenance, traffic, safety, planning, our GIS staff and other key members of our leadership team, it became readily apparent that different departments were collecting duplicate data sets and that working together we could invest in a data set worthy of the UPlan system and our asset management goals."
>
> - Stan Burns, Utah DOT

1. Identify opportunities for data collaboration.

STEP C.4.1	Identify opportunities for data collaboration
Description	Data collaboration opportunities can be pursued to lower costs of existing data programs or to investigate ways of tapping in to additional data sources to supplement what is already collected. With respect to existing data programs, a logical starting point for identifying opportunities for data collection efficiencies is a compilation of existing initiatives and their costs. This information can help the agency to target areas with substantial costs. **Specific opportunities can be sought for data collaboration in order to make best use of available resources. These may include:** • Consolidating data collection initiatives. For example, collection of curve and grade data for safety analysis as part of automated pavement data collection. • Utilizing videologs or LiDAR imagery to extract multiple data attributes. • Designating responsibilities for updating data about highway inventory and condition as an integral part of construction project closeout and maintenance management processes to reduce the need for complete re-collection of data. • Establishing a data clearinghouse that facilitates sharing of data collected by multiple agencies. • Maintaining an agency data catalog and requesting that staff check existing data availability prior to embarking on new data collection efforts. • Establishing data sharing agreements with private sector organizations. For example, to obtain real-time travel information in exchange for information about construction schedules and reported incidents. • Collaborating with regional partners to share costs of acquiring data sets of common interest. • Coordinating data collection across multiple jurisdictions through a regional or statewide body that sets standards and provides support for consistent data collection and reporting, and consolidates the reported data. Once appropriate strategies are identified, work will be required to negotiate agreements. Data sharing agreements need to articulate processes, roles, responsibilities, and financial

STEP C.4.1	Identify opportunities for data collaboration
	arrangements (each party's contribution – both direct and in-kind). Negotiations will typically also involve discussions to ensure that each party's data requirements will be addressed – considering accuracy, precision, and fit with reporting and analysis timetables. Many data sharing strategies depend on – or can be facilitated by – information technology investments. These can range from relatively simple data portals to specialized applications for data intake, processing, and display. Several examples are provided below.
Examples	**Shared Database: Metro Regional Centerline Collaborative (MRCC)[20]:** The MRCC is a joint collaborative project started in 2014 that involves GIS technical and managerial staff from the seven-county Minneapolis-St. Paul metropolitan area, the Metropolitan Emergency Services Board, and the Metropolitan Council. This group is facilitating the development and maintenance of an authoritative, inter-jurisdictional, publicly available road centerline data model and data set. It is doing this by having each county provide data according to specified standards (i.e., counties "control" their south and west borders and "cede" their north and east borders when edge-matching roads to boundaries). **Once completed, intended use of the data model and data set will include:** • Vehicle routing; • Address geocoding; • Next Generation 911 call routing and location validation; • Emergency services dispatching; • Linear referencing system use; and • Cartographic road feature representation. **Figure C-7: MRCC Data Assembly Process** Source: MRCC Regional Data Maintenance Project[21] 

[20] Metro Regional Centerline Collaborative. (2015). MRCC Regional Data Maintenance Project. Minneapolis, MN. http://www.metrogis.org/getmedia/61cfce67-2f56-4095-980b-42bd4c257f1f/MRCC-First-Build-Charter-2015_08_03.pdf.aspx

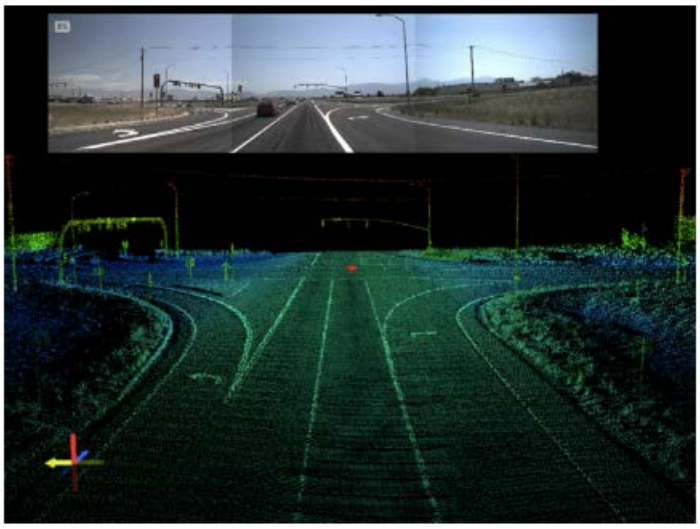
[21] Metro Regional Centerline Collaborative. (2015). MRCC Regional Data Maintenance Project. Minneapolis, MN. http://www.metrogis.org/getmedia/61cfce67-2f56-4095-980b-42bd4c257f1f/MRCC-First-Build-Charter-2015_08_03.pdf.aspx

STEP C.4.1	Identify opportunities for data collaboration

LiDAR Data Collection: Utah Department of Transportation[22]

Utah DOT initiated a LiDAR data collection effort in 2011. This effort involved pooled funding across multiple departments to collect data used for asset management and related business needs. Gathering multiple types of information at the same time lowered overall data collection costs for the agency. The data included pavement condition, roadway geometrics, and roadway asset inventory.

Figure C-8: LiDAR Data Collection
Source: Utah Department of Transportation[23]



UPlan: Utah Department of Transportation[24]:

Utah DOT has created the UPlan interactive mapping platform to improve data sharing. UDOT can integrate any publicly available spatial data into UPlan. Stakeholders can also share geospatial layers with UDOT, which improves collaborative decision-making by ensuring that the agency and stakeholders can view the same information (e.g., for assessing project impacts). UDOT can change access permissions, enabling it to use and share different data sources securely.

Local Road Data Management Tool: Wisconsin Department of Transportation[25]

The Wisconsin Department of Transportation has developed the Wisconsin Information System for Local Roads (WISLR) to manage local road data. The internet-accessible system combines local road data with interactive mapping functionality. It allows local governments to report local road information (e.g., width, surface type, surface year, shoulder, curb, road

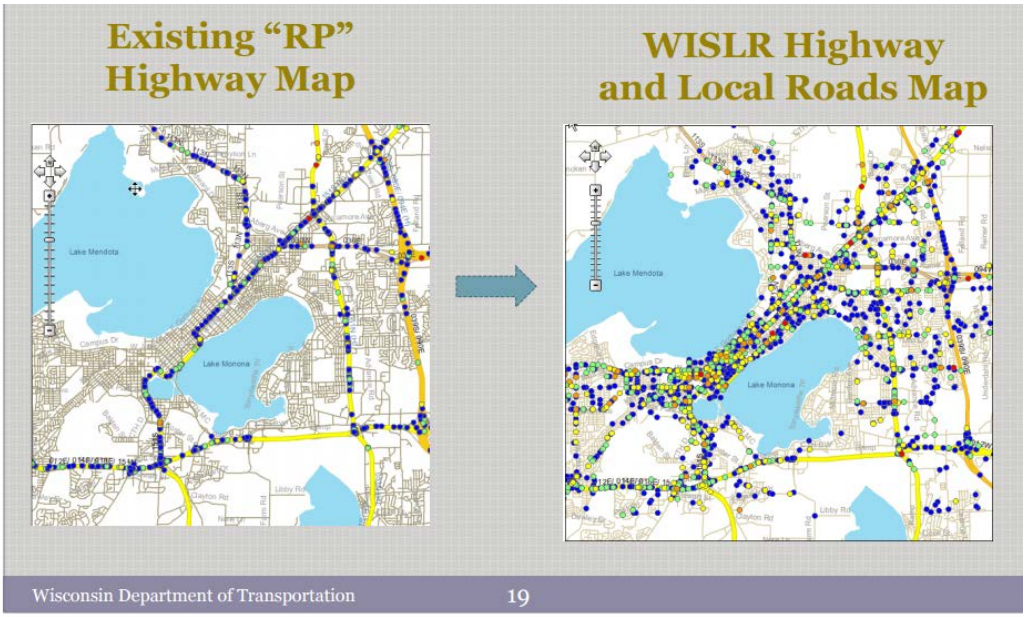
[22] NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide (November 2015). http://www.trb.org/Main/Blurbs/173470.aspx
[23] Utah Department of Transportation. (2011). Utah DOT Leveraging LiDAR for Asset Management Leap. Taylorsville, UT. https://www.udot.utah.gov/public/ucon/uconowner.gf?n=8336606666333974
[24] FHWA, "Utah's GIS Database Enhancing Transportation Performance Management," TPM Noteworthy Practice Series http://www.fhwa.dot.gov/tpm/noteworthy/hif13022.pdf.
[25] Wisconsin Department of Transportation, "Wisconsin Information System for Local Roads (WISLR). http://wisconsindot.gov/Pages/doing-bus/local-gov/wislr/default.aspx.

STEP C.4.1	Identify opportunities for data collaboration

category, functional classification, pavement condition ratings) to Wisconsin DOT and then use WISLR's analytical tools, including mapping and tabulations. Local governments can update and edit their data. This system leads to statewide collaboration in which both the Wisconsin DOT and the local governments benefit from each other.

Figure C-9: WisDOT Safety Analysis Tool

Source: Wisconsin Department of Transportation[26]



Using Private Sector Data: Florida Department of Transportation[27]

In 2011, Florida DOT studied bottlenecks on its Strategic Intermodal System using vehicle probe data and travel time reliability measures. The private vehicle probe data combine real-time data from traditional sensors, GPS-enabled vehicles, and other factors. The GPS-enabled vehicles include trucks, taxis, buses, and passenger cars that have onboard GPS devices and a capability to transmit speed and location back to a central location anonymously. Florida DOT purchased this speed data in five-minute intervals for a one-year data period, which included 711 million records. Based on these data, Florida DOT was able to calculate performance measures related to travel time and congestion, and identified bottlenecks in the state's Strategic Intermodal System.

More recently, Florida DOT negotiated a data sharing agreement with a different private navigation services provider. Under this agreement, the private provider allows FDOT access to real-time travel and incident data. In return, FDOT allows the private provider to use the agency's data within its app.

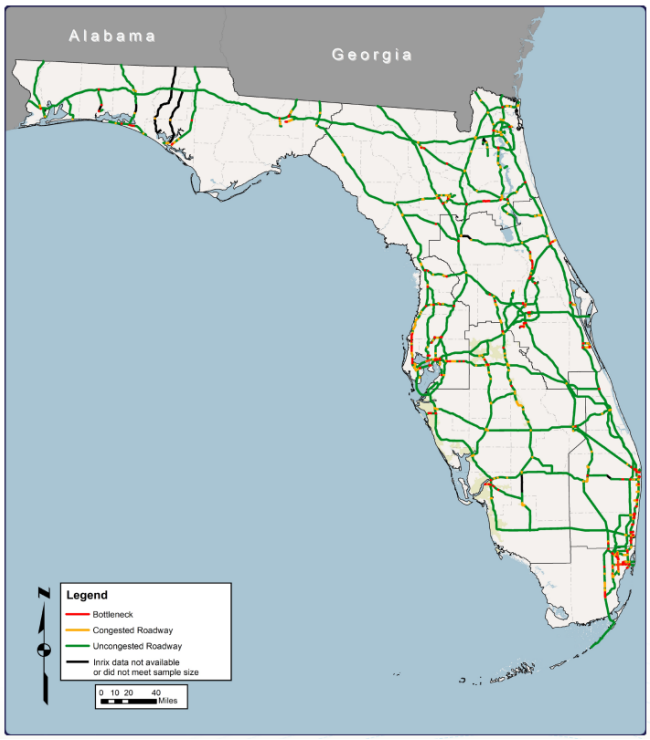
[26]Wisconsin Department of Transportation. (2013). Wisconsin Information Systems for Local Roads. Madison, WI. http://www.atsip.org/program/Presentations2013/S15_Ford_Dataprograms.pdf

[27] Florida Department of Transportation. (2012). Bottlenecks on Florida's SIS: Year 2011. Tallahassee Florida. http://www.dot.state.fl.us/planning/systems/programs/mspi/pdf/Executive%20Summary-letter%202-15-13.pdf

STEP C.4.1	Identify opportunities for data collaboration

Figure C-10: FDOT Public/Private Traffic Data Sharing

Source: Florida Department of Transportation[28]



Regional Data Coordination: Michigan Asset Management Council

The Michigan Transportation Asset Management Council (TAMC) was established to expand the practice of asset management statewide to enhance the productivity of investing in Michigan's roads and bridges. One of the TAMC's key functions is coordination of collection of physical inventory and condition data on all roads and bridges in Michigan. Each member agency must report to the Council the mileage and condition of road and bridge systems under their jurisdiction. The Council establishes data standards, data collection processes and tools for each agency to use, and consolidates the information that is collected. The Council's role and authority was established through Michigan state law (Act 51).[29]

Linkages to Other TPM Components		
	Component 05: Monitoring and Adjustment	(See TPM Framework)
	Component 06: Reporting and Communication	
	Component A: Organization and Culture	
	Component B: External Collaboration	

[28] Florida Department of Transportation. (2012). Bottlenecks on Florida's SIS: Year 2011. Tallahassee Florida. http://www.dot.state.fl.us/planning/systems/programs/mspi/pdf/Executive%20Summary-letter%202-15-13.pdf

[29] Michigan Transportation Asset Management Council. http://www.mcgi.state.mi.us/tamc/#/

C.5 DATA GOVERNANCE

Data governance is the mechanism by which data-related decisions are made. It allows agencies to define standard data management practices and ensure that they are carried out in a consistent fashion. Strong data governance is integral to the success of initiatives to improve data quality, integration and access. Every agency already has policy and decision making structures and authorities in place. Data governance can build on these existing structures to formalize policies, roles and responsibilities related to data. This subcomponent covers key activities to consider for strengthening data governance in support of TPM.

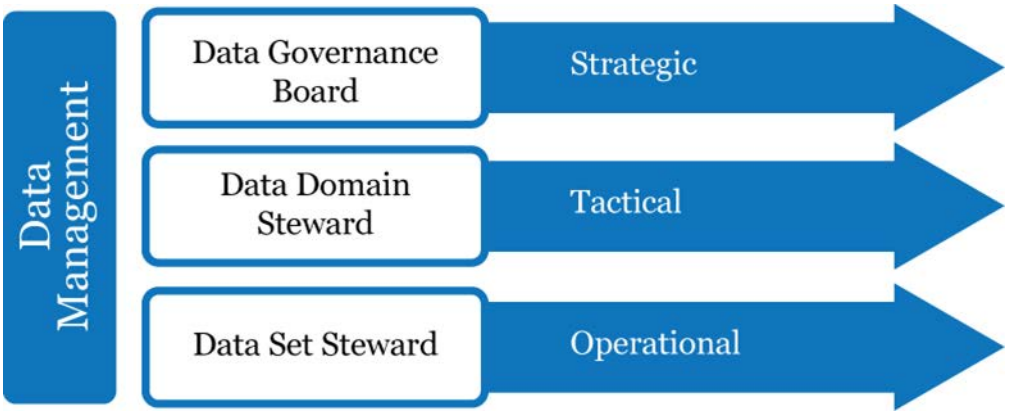
1. Define roles and accountability
2. Implement governance structures and policies

> "A data governance framework helps to strengthen the overall data management process within an organization by defining the roles and responsibilities for data stewards, data architects, data coordinators and business owners, along with other data stakeholders within the context of the existing organizational structure."
>
> Source: Minnesota Department of Transportation, Data Business Plan

STEP C.5.1	Define roles and accountability
Description	A good starting point for data governance is to document current data roles. This will provide an understanding of the current baseline situation, and will help to uncover gaps and ambiguities in responsibilities. Once current roles are understood and gaps identified, the agency can move toward standardizing and formalizing roles and making sure that accountability for these roles is established. This process will help equip the agency to proactively address its data needs. Agencies can choose to focus data governance efforts on a small number of critical data sets for TPM, or to take a more comprehensive approach. The first step is to create a list of the data sets of interest. For TPM, these may include pavement and bridge inventory and condition data, traffic data, crash and fatality data, road inventory data, capital program data, network model data, analysis results, etc. Then, for each of these data sets, identify: **Data Stewardship Responsibilities:** • Who is responsible for defining what data should be collected/produced and how – the data elements, the frequency of collection/production, and the methods of collection/production? • Who is responsible for defining data validation rules? • Who is responsible for quality review and acceptance of the data? • Who is responsible for answering questions about the meaning, derivation and limitations of the data? • Who is responsible for creating and maintaining business metadata? • Who is responsible for deciding who can access the data and approving special data requests? **Data Custodian Responsibilities:** • Who is responsible for setting up and managing the hardware and software for managing the data?

STEP C.5.1	Define roles and accountability
	• Who is responsible for loading the data into a database or repository for access? • Who is responsible for creating and maintaining technical metadata? • Who is responsible for setting up data access environments (e.g., reporting tool configuration)? • Who is responsible for fulfilling data requests? • Who is responsible for data cleansing (e.g., applying data validation rules)? • Who is responsible for backing up the data? From the perspective of data governance, it is useful to distinguish points of accountability for each function; it is not necessary to exhaustively identify each individual who is involved. While not all of these questions will be applicable to each data set, they can be used to identify business units and positions within these units who currently play stewardship and custodial roles for data. Typically the custodians will be located in an information technology or data management unit – but not always. In many cases, the same individual will serve as both a data steward and a data custodian. Documentation and formalization of data roles will identify key points of contact for each data set. It is also likely to lead to productive discussions about formalizing accountability in areas that are currently not well defined. Roles and responsibilities should be documented, and ideally built into employee position descriptions so that the responsibilities are clear, defined, and viewed as an integral component of an employee's job. It is important to note that defining data management responsibilities and designating staff to be accountable for these responsibilities is a necessary but not sufficient step. Staff assigned to various data roles must have sufficient time, training, and authority to carry out their responsibilities.
Examples	**Data Stewardship: Minnesota Department of Transportation[30]** As part of its efforts to strengthen data governance, Minnesota DOT established data stewardship roles and responsibilities in a variety of data domains. **These domains include:** • Human resources data • Financial data • Planning, programming, and project data • Business and customer data • Spatial data • Regulatory data • Recorded events data • Supporting assets data Within these domains, Minnesota DOT has identified 120 subject area stewards. These stewards meet monthly along with a representative from the statewide Information Technology group.

[30] Minnesota Department of Transportation. (2013). Data Business Plan. St. Paul, MN. http://www.dot.state.mn.us/tda/databusinessplan.docx.

STEP C.5.1	Define roles and accountability
	The focus of steward responsibilities to this point has been on: • Scoping information technology projects in the context of identified data principles to minimize redundancies and foster discussion of how a project in one area may have broader impacts on other areas or data systems in the department • Identifying enterprise and authoritative sources of data and clarifying ownership responsibilities • Discussing data retention needs and policies • Reviewing data access policies • Identifying data sharing opportunities within and external to the department and developing service level agreements to establish expectations. **Figure C-11: MnDOT Data Management** Source: Data Business Plan[31] 
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework) Component D: Data Usability and Analysis Capabilities

STEP C.5.2	Implement governance structures and policies
Description	Step C.5.1 emphasized a "bottom-up" approach, i.e., documenting and formalizing data stewardship and management roles at the level of individual data sets. In order to make sure that the agency is equipped to make new data investments and improvements that are cross-cutting in nature, a "top down" agency-wide structure for data governance can be helpful. An agency-wide structure will typically involve a high level strategic group with representation of different divisions (both business and IT) to set policy and make key investment decisions. It will also involve a more tactical team responsible for policy execution, data strategy and solution development and coordination. For the strategic level, agencies can choose to establish a new data governance council or it can piggyback on already existing leadership teams. Similarly, an agency may already have a data management unit that can provide tactical support – or a new data governance team can be designated.

[31] Minnesota Department of Transportation. (2013). Data Business Plan. St. Paul, MN. http://www.dot.state.mn.us/tda/databusinessplan.docx.

STEP C.5.2	Implement governance structures and policies
	Data policies provide the basis for moving from an ad-hoc approach to data management to a more consistent and repeatable approach. For example, if the agency wants data to be integrated based on spatial location, policies need to be established that require business units that collect data to adhere to location referencing standards. **The following types of data policies can be considered:** • Policies that define responsibilities of data stewards and custodians • Policies that reference data standards to be followed • Policies that specify where different types of data are to be stored • Policies that specify how different types of data are to be made available • Policies that define how data access is to be managed • Policies that define data quality management processes to be followed • Policies that define a process to be followed prior to new data collection (i.e., verify that the new data doesn't duplicate existing data, and that a strategy for management and updates has been established) • Policies that define data change management processes • Policies that encourage data sharing • Policies that define sensitive and confidential data and ensure protection of these data types • Policies that require minimum metadata and designate where that metadata should be stored Policies can be defined and rolled out incrementally, based on where the biggest issues are that impede data quality, integration, and access. **Each policy should have a well thought-out implementation plan that considers likely barriers to acceptance, such as:** • Lack of understanding about why the policy is needed and what benefits it provides • Lack of direction on how to implement the policy • Lack of resources to make additional effort that is not critical to the mission of an individual business unit • Lack of tools to facilitate policy adherence (e.g., a metadata repository) • Lack of management willingness to enforce the policy Overcoming these barriers will require initial and ongoing steps to ensure management buy-in (at multiple levels), development of support documents, such as "how to" guides, allocation of staff time to meet with and support individuals who are impacted by the policy, and (in some instances) implementation of new tools. A periodic review of policies and their implementation will be helpful for identifying ways to address lingering issues.
Examples	**Knowledge Management Governance Oversight Committee: Colorado Department of Transportation[32]** The Colorado DOT established a Knowledge Management Governance Oversight Committee, whose vision was to implement policies, procedures, and standards to be used to manage

[32] NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide (November 2015). http://www.trb.org/Main/Blurbs/173470.aspx

STEP C.5.2	Implement governance structures and policies

information, data and content within Colorado DOT.

The Committee is responsible for developing a strategy and process to implement knowledge management governance throughout the organization, including:

- Prioritizing direction for governance implementation and prioritizing governance tasks;
- Guiding the development of a governance manual to document the framework
- Developing a plan to communicate the data governance initiative throughout the agency; and
- Developing a process for change management and training to support the data governance initiatives.

The Committee is also responsible for creating and recommending a governance framework, which would:

- Define governance roles and responsibilities;
- Define goals and objectives for data, information, and content creation, retention, distribution, and use;
- Identify the value, use, and priority of information, data, and content; and
- Define requirements for a knowledge catalog development for the agency.

FHWA Data Governance Plan[33]

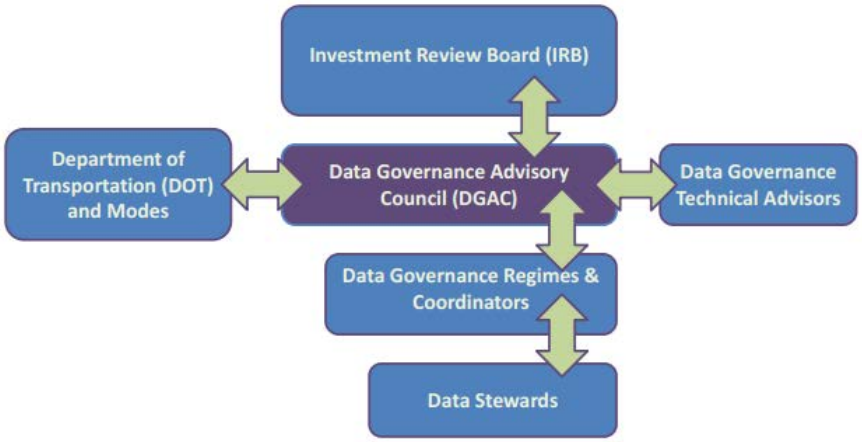
FHWA is in the process of developing a plan for agency-wide data governance. The first volume is complete, providing a "Data Governance Primer." Additional volumes of the FHWA data governance plan, when complete, will address enterprise architecture, data analytics and storage, master reference data, and open data. The plan currently provides a hierarchical framework for data policies, standards, and procedures. The policies are high-level outcomes consistent with strategic goals and objectives (e.g., "FHWA data are an enterprise asset"). The data standards provide additional detail on policy implementation and can cut across multiple policies (e.g., "Data Definition Conformity: Data Definitions must be established and specified between mapping entities and variables"). Finally, the data procedures provide further detail on applying data rules. The FHWA data governance efforts have a three-tier hierarchy consisting of the Data Governance Advisory Council, Data Governance Regimes and Coordinators, and Data Stewards.

[33] Federal Highway Administration. (July 2015). FHWA Data Governance Plan, Volume 1: Data Governance Primer" (July 2015). Washington, DC. https://www.fhwa.dot.gov/datagov/dgpvolume%201.pdf

STEP C.5.2	Implement governance structures and policies

Figure C-12: FHWA Data Governance Structure

Source: Federal Highway Administration[34]



Linkages to Other TPM Components

Component 01: Strategic Direction (See TPM Framework)

Component A: Organization and Culture

Component D: Data Usability and Analysis Capabilities

[34] Federal Highway Administration. (July 2015). FHWA Data Governance Plan, Volume 1: Data Governance Primer" (July 2015). Washington, DC. https://www.fhwa.dot.gov/datagov/dgpvolume%201.pdf

RESOURCES

Resource	Year	Link
TPM Toolbox	2016	www.tpmtools.org
Improving Safety Data Programs Through Data Governance and Data Business Planning	2015	http://onlinepubs.trb.org/onlinepubs/circulars/ec196.pdf
FHWA Traffic Monitoring Guide, Appendix E., Compendium of Quality Control Criteria	2013	http://www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/compendium-data-quality.cfm
How to Develop a Data Management and Sharing Plan	2011	http://www.dcc.ac.uk/resources/how-guides/develop-data-plan
Private Sector Data for Performance Management	2011	http://www.ops.fhwa.dot.gov/publications/fhwahop11029/fhwahop11029.pdf
NCHRP Report 666: Target Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_666.pdf
NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_814.pdf
FHWA Volume 1: Data Governance Primer	2015	http://www.fhwa.dot.gov/datagov/dgpvolume%201.pdf
FHWA Data Integration Primer	2010	http://www.fhwa.dot.gov/asset/dataintegration/if10019/dip00.cfm
NOAA Plan for Increasing Public Access to Research Results	2015	http://docs.lib.noaa.gov/noaa_documents/NOAA_Research_Council/NOAA_PARR_Plan_v5.04.pdf
NASCIO Governance Series	2008-2009	http://nascio.org/Portals/0/Publications/Documents/NASCIO-DataGovernance-Part1.pdf http://nascio.org/Portals/0/Publications/Documents/NASCIO-DataGovernancePTII.pdf http://nascio.org/Portals/0/Publications/Documents/NASCIO-DataGovernancePTIII.pdf
FHWA Data Quality White Paper	2008	http://ops.fhwa.dot.gov/publications/fhwahop08038/pdf/dataqual_whitepaper.pdf
FHWA Asset Management Data Collection for Supporting Decision Processes	2006	http://www.fhwa.dot.gov/asset/dataintegration/if08018/assetmgmt_web.pdf
FHWA Traffic Data Quality Measurement	2004	http://ntl.bts.gov/lib/jpodocs/repts_te/14058.htm
FHWA GIS-T Operating Agreements Page		https://www.gis.fhwa.dot.gov/gdc_agreements.asp
New York State Department of		https://gis.ny.gov/gisdata/inventories/member.cfm?Org

Resource	Year	Link
Transportation – NYSGIS Clearinghouse		anizationID=539
The Data Management Association Data Management Body of Knowledge		http://www.dama.org/content/body-knowledge
International Association for Information and Data Quality		http://iaidq.org/

ACTION PLAN

1. Of the TPM subcomponents discussed in this chapter, which one would you like to work on?

❑ C.1 Data Quality ❑ C.2 Data Accessibility ❑ C.3 Data Standardization and Integration

❑ C.4 Data Collection Efficiency ❑ C.5 Data Governance

2. What aspect of the TPM process listed above do you want to change?

3. What "steps" discussed in this chapter do you think could help you address the challenge noted above?

Data Quality	Data Accessibility	Data Standardization and Integration	Data Collection Efficiency	Data Governance
❑ Establish data quality metrics	❑ Establish requirements for different audiences	❑ Assess data against standards and requirements	❑ Identify opportunities for data collaboration	❑ Define roles and accountability
❑ Create data validation rules	❑ Enhance data access methods and tools	❑ Create and implement a data integration plan		❑ Implement governance structures and policies
❑ Develop quality management processes				

4. To implement the "step" identified above, what actions are necessary, who will lead the effort, and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success and what solutions did this guidebook provide?

6. Who is someone (internal and/or external) I will collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

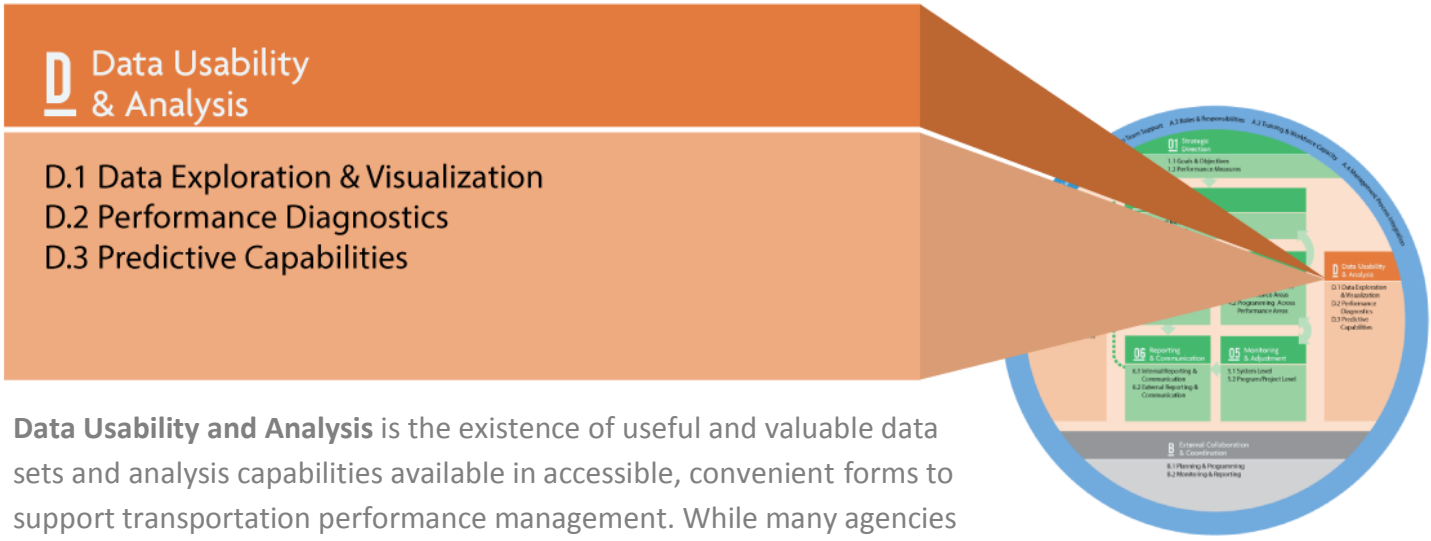
TABLE INDEX

U.S. Department of Transportation
Federal Highway Administration

COMPONENT D

DATA USABILITY AND ANALYSIS

This chapter provides assistance to transportation agencies with the "Data Usability and Analysis" component of Transportation Performance Management (TPM). It discusses how data usability and analysis fit within the TPM Framework, describes how this component interrelates with the other nine components, presents definitions for associated terminology, and includes an action plan exercise. Key implementation steps are the focus of the chapter. Guidebook users should take the TPM Capability Maturity Self-Assessment (located in the TPM Toolbox at www.tpmtools.org) as a starting point for enhancing TPM activities. It is important to note that federal regulations for data usability and analysis may differ from what is included in this chapter.



Data Usability and Analysis is the existence of useful and valuable data sets and analysis capabilities available in accessible, convenient forms to support transportation performance management. While many agencies have a wealth of data, such data are often disorganized, or cannot be analyzed effectively to produce useful information to support target setting, decision making, monitoring or other TPM practices.

INTRODUCTION

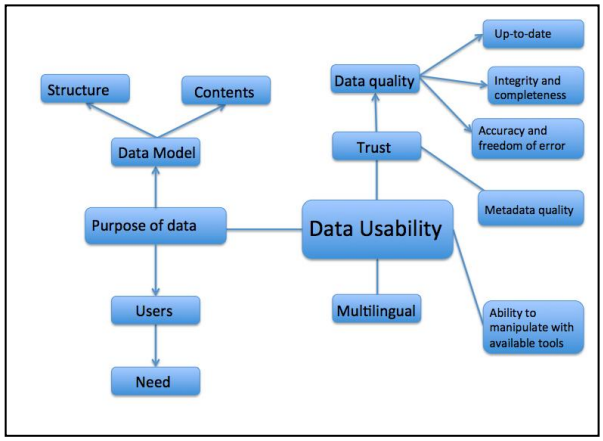
As illustrated in Figure D-1, each of the framework components depend on the existence of relevant data sets, provided in usable, convenient forms to support transportation performance management. This chapter covers steps that can be used to systematically assess data and analysis requirements, select tools, implement analysis capabilities, and develop and improve these capabilities over time.

Data *usability* considers the ability of a user to derive useful information from data. Data provided in a series of text files that require weeks of complex processing to be in a form suitable for analysis are not very usable. On the other hand, data delivered on a performance dashboard that can be immediately interpreted would be highly usable. Data usability is one of the key criteria included in the data value assessment process featured in NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide (see pages 38-39 and 42-43 of this reference for data usability assessment criteria and examples).

There are multiple dimensions to data usability:

Figure D-1: Elements of Data Usability

Source: Adapted from Directions Magazine[1]



- **Relevance:** data must address an information need
- **Quality:** data must be of acceptable quality for the intended purpose
- **Coverage and Granularity:** data must have adequate coverage and be structured at the right level of granularity
- **Accessibility and Documentation:** data must be accessible, with sufficient metadata for potential users to understand their derivation and meaning
- **Ease of Analysis:** appropriate tools must be available to manipulate the data (e.g., filtering, sorting, and aggregating) and viewing the data (e.g., mapping and charting). In some cases, specialized methodologies and tools are needed to perform statistical analysis or predictive modeling

A proactive approach to data usability can ensure that available data are put to good use for TPM. Agencies should examine not only the data and tools that are available for performance monitoring and reporting but also the backgrounds and capabilities of the staff who will be analyzing and using the data. For example:

- Do they know what questions to ask about the data?
- Do they understand how the data were collected?
- Do they understand the data's level of accuracy and precision?
- Do they understand the precise definitions of the data elements?
- Are they familiar with changes that may have occurred over time in data collection methods and definitions?
- Do they understand how variations in filter conditions may impact results?
- Are they familiar with tools and techniques for presenting data in a useful way?

[1] Dr. Iain Cross and Joana Palahi. Evaluating the Usability of Aggregated Datasets in the GIS4EU Project. (2010). Glencoe, IL. http://www.directionsmag.com/entry/evaluating-the-usability-of-aggregated-datasets-in-the-gis4eu-project/122329

- Do they have access to specialized expertise in data integration, data manipulation and statistical analysis that may be required for performance trend analysis, diagnostics, and prediction?

A transportation performance management skills assessment can include these questions in order to recognize and understand potential challenges that will need to be addressed to ensure a strong transportation performance management capability. There may be a need to build staff capacity in data analysis methods through recruiting, training, and mentoring. Collaboration within the agency can be used to leverage available expertise internally. For example, staff within an agency data management unit can be tapped to provide advisory services to staff within an operations performance function. Outsourcing can be used as a strategy for gaining specialized skills and providing internal staff with exposure to new techniques. See subcomponent A.3 Training and Workforce Capacity for further discussion.

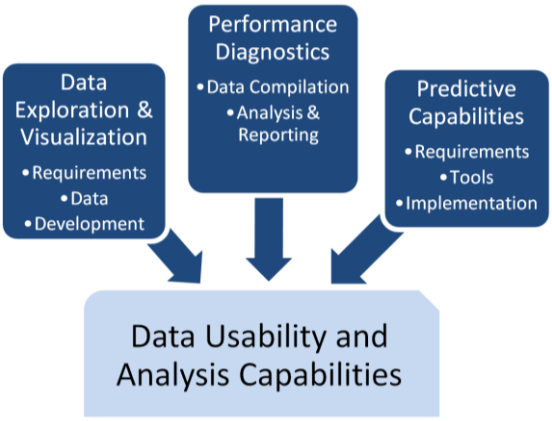
External collaboration can be pursued to help provide the necessary capabilities when partner agencies share common performance monitoring and reporting needs. In this situation, available staff resources can be pooled to take advantage of complementary skill sets across agencies. Staff roles and responsibilities can be negotiated as part of data-sharing agreements. See External Collaboration and Coordination (Component B), subcomponent B.2 Monitoring and Reporting.

SUBCOMPONENTS AND IMPLEMENTATION STEPS

Figure D-2: Subcomponents for Data Usability and Analysis

Source: Federal Highway Administration

Data Usability and Analysis is defined here as: the existence of useful and valuable data sets and analysis capabilities available in accessible, convenient forms to support transportation performance management. While many agencies have a wealth of data, it may not be in the right form to allow for visualization or analysis to support target setting, decision-making, monitoring, or other TPM practices. Agency efforts to process data into convenient forms, provide useful visualization and analysis tools, and build staff capacity will directly impact an agency's ability to understand and improve performance.



Ensuring usability of data for transportation performance management involves considering three types of capabilities (Figure D-2):

- **Data Exploration and Visualization:** availability and value of data, tools, and reports for understanding performance results and trends.
- **Performance Diagnostics:** availability and value of data, tools, and reports that allow an agency to understand how influencing factors affected performance results both at the system and project levels.
- **Predictive Capabilities:** availability and value of analytical capabilities to predict future performance and emerging trends.

These three capabilities are interrelated. Data exploration and visualization capabilities build a foundation for performance diagnostics by allowing agencies to explore variations in performance over time, across the network, and for other subsets of interest. Through this process, questions intuitively arise about reasons for performance

variations. These questions lead to identification of additional data sets and views that could be helpful for performance diagnostics. Performance diagnostics capabilities contribute to establishment of predictive capabilities. Once causal factors behind performance results are understood, models can be created based on relationships between independent variables (such as funding levels, programmed projects, VMT, growth patterns, etc.) and performance measures of interest.

As illustrated in Table D-1, Table D-2, and Table D-3 these interrelated capabilities contribute to each of the fundamental TPM activities of target setting (Component 02), performance-based planning (Component 03), performance-based programming (Component 04), monitoring and adjustment (Component 05), and reporting and communications (Component 06). For example, the process of setting a performance target for pavement condition is facilitated by the ability to visualize and explore pavement condition trends across geographic areas, road network subsets, and pavement types. This data exploration capability could be used to inform further analysis of major contributing factors to pavement performance (i.e., performance diagnostics). The diagnostic analysis would then support predictive modeling of future pavement performance under varying assumptions.

Table D-1: TPM Activities Requiring Data Usability and Analysis, Subcomponent D.1

Source: Federal Highway Administration

TPM Component	Sample TPM Activities Requiring D.1 Exploration and Visualization Capabilities
02: Target Setting	Visualize trends
03: Performance-Based Planning	Visualize deficiencies and needs to inform strategy development Visualize impacts of alternative investment scenarios
04: Performance-Based Programming	Track locations of programmed projects against deficiencies
05: Monitoring and Adjustment	Understand timing of programmed project completion
06: Reporting and Communication	Tailor performance reports to different audiences

Table D-2: TPM Activities Requiring Data Usability and Analysis, Subcomponent D.2

Source: Federal Highway Administration

TPM Component	Sample TPM Activities Requiring D.2 Performance Diagnostics
02: Target Setting	Identify factors that have impacted performance trends
03: Performance-Based Planning	Understand impacts of implemented strategies
04: Performance-Based Programming	Understand program effectiveness
05: Monitoring and Adjustment	Diagnose reasons for delays and take appropriate action Identify factors contributing to performance results
06: Reporting and Communication	Explain reasons for performance results

Table D-3: TPM Activities Requiring Data Usability and Analysis, Subcomponent D.3

Source: Federal Highway Administration

TPM Component	Sample TPM Activities Requiring D.3 Predictive Capabilities
02: Target Setting	Assess future ability to achieve targets under varying assumptions
03: Performance-Based Planning	Identify strategies based on projected performance
04: Performance-Based Programming	Predict impacts of programmed projects on multiple performance areas
05: Monitoring and Adjustment	Adjust predictions of program outcomes based on project delivery status Update revenue projections to assess program delivery risk
06: Reporting and Communication	Communicate future implications of investment decisions

It is important to keep in mind that most agencies already have capabilities for data analysis in place. The processes defined in this guidebook can be viewed as a way to build on existing capabilities in order to strengthen the value of data for transportation performance management. Table D-4 outlines implementation steps for each of these capabilities that will be further explored in this chapter.

Table D-4: Data Usability and Analysis Implementation Steps

Source: Federal Highway Administration

Data Exploration and Visualization	Performance Diagnostics	Predictive Capabilities
1. Understand requirements	1. Compile supporting data	1. Understand requirements
2. Assess data usability	2. Integrate diagnostics into analysis and reporting processes	2. Identify and select tools
3. Design and develop data views		3. Implement and enhance capabilities

CLARIFYING TERMINOLOGY

Table D-5 presents the definitions for the data usability and analysis terms used in this Guidebook. A full list of common TPM terminology and definitions is included in Appendix C: Glossary.

Table D-5: Data Usability and Analysis: Defining Common TPM Terminology

Source: Federal Highway Administration

Common Terms	Definition	Example
Data Exploration and Visualization	Presentation of data in a graphical form to enable interactive analysis and facilitate understanding and communication.	Common TPM data visualizations include maps showing highway links with poor performance, trend lines showing average crash rates, and dashboards showing charts with key performance indicators.

Common Terms	Definition	Example
Data Usability	The ease with which user information needs can be met with available data, tools, and skills.	A data feed of highway travel speeds is not usable in its raw form. Data processing, summarization and presentation are required to make this data feed usable.
Imputation	Substitution of estimated values for missing or inconsistent data element values.	A probe data set consisting of speeds by five-minute period for each section of an Interstate may have missing data due to insufficient observations for some periods/sections. Data for these periods/sections may be imputed based on values for nearby sections.
Performance Diagnostics	Analysis of root causes for performance results.	Correlating traffic incidents with travel speed data; breaking down crash data by contributing factors recorded in crash records or highway inventories.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.

RELATIONSHIP TO TPM COMPONENTS

As noted above, Data Usability and Analysis are an integral part of TPM and are touched upon in the other chapters of this guidebook. Table D-6 summarizes how each of the nine other components relate to Component D.

Table D-6: Data Usability and Analysis Relationship to TPM Components

Source: Federal Highway Administration

Component	Summary Definition	Relationship to Data Usability and Analysis
01. Strategic Direction	The establishment of an agency's focus through well-defined goals/objectives and a set of aligned performance measures.	Establishing performance measures that can realistically be tracked requires consideration of data and analysis requirements.
02. Target Setting	The use of baseline data, information on possible strategies, resource constraints and forecasting tools to collaboratively establish targets.	Establishing performance targets requires analysis and interpretation of available trend data, as well as capabilities for predicting future performance under varying assumptions.
03. Performance-Based Planning	Use of a strategic direction to drive development and documentation of agency strategies and priorities in the long-range transportation plan and other plans.	Data usability and analysis support evaluation of alternative mid and long-range scenarios.

Component	Summary Definition	Relationship to Data Usability and Analysis
04. Performance-Based Programming	Allocation of resources to projects to achieve strategic goals, objectives and performance targets. Clear linkages established between investments made and their expected performance outputs and outcomes.	Performance-based programming requires application of analysis capabilities for evaluation of the performance outcomes of candidate projects for programming.
05. Monitoring and Adjustment	Processes to monitor and assess actions taken and outcomes achieved. Establishes a feedback loop to adjust programming, planning, and benchmarking/target setting decisions. Provides key insight into the efficacy of investments.	Data usability and analysis are integral to performance monitoring–they are needed to support the process of understanding patterns, identifying key performance drivers, and pinpointing areas for improvement.
06. Reporting and Communication	Products, techniques, and processes to communicate performance information to different audiences for maximum impact.	Data visualization capabilities are essential for effective communication of performance information to different audiences.
A. TPM Organization and Culture	Institutionalization of a TPM culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support TPM.	Data visualization capabilities enable a shared picture of performance that supports an agency performance culture.
B. External Collaboration and Coordination	Established processes to collaborate and coordinate with agency partners and stakeholders on planning/ visioning, target setting, programming, data sharing, and reporting.	Data visualization capabilities enable a shared picture of performance that supports external collaboration.
C. Data Management	Established processes to ensure data quality and accessibility, and to maximize efficiency of data acquisition and integration for TPM.	Data management practices are essential for strengthening data usability for TPM.

IMPLEMENTATION STEPS

D.1 DATA EXPLORATION AND VISUALIZATION

Data Exploration and Visualization is defined here as the presentation and/or manipulation of data in a graphical form to facilitate understanding and communication. The process of improving exploration and visualization capabilities begins by identifying the questions that the agency would like to answer. Once this is done, gaps in data and analysis can be assessed, and improvements can be designed.

1. Understand requirements
2. Assess data usability
3. Design and develop data views

> "You can have data without information, but you cannot have information without data."
>
> - Daniel Keyes Moran, Programmer

> "Above all else, show the data."
>
> - Edward R. Tufte, Data Visualization Thought Leader

STEP D.1.1	Understand requirements

Description	To assess data usability, agency staff must first identify what questions need to be answered, and what data sources are needed to address these questions. Once this is done, the agency can evaluate data adequacy and define data exploration and visualization requirements. While the specific questions will depend on the performance area, the following types of questions will generally be applicable:
	• What is the current level of performance?
	  ○ How does it vary across types of related measures (pavement roughness, rutting, cracking)?
	  ○ How does it vary across transportation system subsets (district, jurisdiction, functional class, ownership, corridor)?
	  ○ How does it vary by class of traveler (mode, vehicle type, trip type, age category)?
	  ○ How does it vary by season, time of day, or day of the week?
	• Is observed performance representative of "typical" conditions or related to unusual events or circumstances (storm events or holidays)?
	• How does performance compare with peers and the nation as a whole?
	• How does current performance compare with past trends?
	  ○ Are things stable, improving, or getting worse?
	  ○ Is current performance part of a regularly-occurring cycle?
	• What factors have contributed to the current performance?
	  ○ What factors can the agency influence (hazardous curves, bottlenecks, pavement mix types)?
	  ○ How do changes in performance relate to general socio-economic or travel trends (economic downturn, aging population, lower fuel prices contributing to increase in driving)?
	• How effective have past actions to improve performance been (safety improvements, asset preventive maintenance programs, incident response improvement)?
	Based on these questions, agencies can create a chart similar to that in Table D-7 to identify data sources and understand analysis requirements. Because agencies typically will not have

STEP D.1.1	Understand requirements

all desired data, it is helpful to prioritize requirements to begin rolling out basic data exploration and visualization capabilities and have a plan for future expansion of these capabilities.

Examples

Auto Report Generator: Utah Department of Transportation[2]

Utah DOT's Auto Generator allows users to enter project limits on a straight-line diagram and generate a spreadsheet that can be used to prepare an engineer's estimate. This is an example of building a tool that presents existing data (asset data collected via LiDAR) in a form that is immediately useful for addressing a specific business question: what is the cost of replacing existing assets within a given location? The summary spreadsheet provides data related to pavements, pavement markings, barriers, and signs. Engineers can then use this information to verify measurements and other details (e.g., sign damage, non-standard barriers) in the field.

Table D-7: Safety Data Requirements Analysis (Examples)

Source: Utah Department of Transportation[3]

Question	Data Elements	Coverage	Granularity
How does the current level of highway safety performance compare with past trends?	Fatality Rate–based on number of highway fatalities and vehicle miles of travel	Spatial: All public roads statewide Temporal: 1995-2015	Spatial: by road class and jurisdiction Temporal: Annual Other: Age Category
What factors have contributed to the current level of performance?	Crash record attributes (first harmful event, etc.) Road inventory attributes Emergency Medical Response Attributes	Linkage to crash records to provide same coverage as dependent variable (fatality rate)	Linkage to crash records to provide same granularity as dependent variable (fatality rate)

Linkages to Other TPM Components

Component 02: Target Setting

Component 03: Performance-Based Planning

Component 04: Performance-Based Programming

Component 05: Monitoring and Adjustment

Component 06: Reporting and Communication

Component B: External Collaboration and Coordination

(See TPM Framework)

[2] Utah Department of Transportation, "Auto-generated summary sheets" (June 18, 2014), http://blog.udot.utah.gov/2014/06/auto-generated-summary-sheets/.

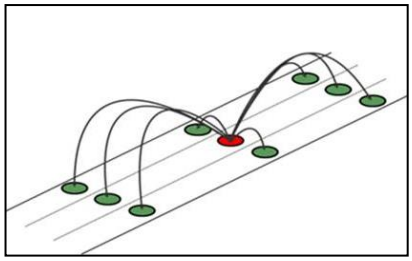
[3] Utah Department of Transportation, "Auto-generated summary sheets" (June 18, 2014), http://blog.udot.utah.gov/2014/06/auto-generated-summary-sheets/.

STEP D.1.2	Assess data usability
Description	Once data requirements are identified, the next step is to examine the available data and determine its usability. **Questions to ask in assessing data usability include:** • Are relevant data available, i.e., that can provide answers to the applicable questions? • Are the data of sufficient quality for the purpose–are they sufficiently accurate, complete, consistent and current? • Do the data have sufficient coverage to meet business needs–both spatially and temporally? • Are the data available at the right level of granularity to meet business needs? • Where multiple overlapping sources of data are available, is it clear which is authoritative? Inevitably there will be gaps in the existing data. Some gaps can be filled through new data collection or acquisition initiatives. Because acquisition of new data comes at a cost, it is necessary to consider the value that the new data would bring and whether existing data could suffice. Other gaps will not be possible to fill through acquisition of new data–for example, a trend data set might be missing data for certain years, or historical data may be based on a different measurement method than current data. These types of gaps need to be addressed on a case-by-case basis. In some cases, imputation methodologies can be used to fill in missing data. In addition, data transformation methods can be applied to convert across measures (where statistically reliable relationships can be established). In other cases, the agency can decide to just live with the missing data.
Examples	**Crash Data Quality Assessment** The University of Massachusetts UMassSafe program, with participation from the Massachusetts Traffic Records Coordinating Committee (TRCC) conducted an audit of data quality issues in the Massachusetts Crash Data System (CDS). **Key issues discovered included:** • High rate of missing injury severity data: injury severity is missing for approximately 25% of cases. • Poor location information: location information collected on the crash form varies greatly. • Poor data quality for engineering-related fields: while injury severity is perhaps the most substantial field with a high percentage of missing information, there are other fields that share similar problems.[4]

[4] UMassSafe Traffic Safety Research Program. Crash Data Quality Audit. http://www.ecs.umass.edu/masssafe/cdqa.htm. Retrieved 15 July 2016.

STEP D.1.2	Assess data usability

Figure D-3: Imputation Model
Source: Transportation Research Board[5]



Each of these types of errors impacts usability of data for tracking highway safety performance. Missing injury severity data impacts the ability to meaningfully track serious injuries. Poor location information impacts ability to summarize the data by geographic area and to visualize the data on a map. Poor quality data for other crash record fields impacts the ability to understand causal factors.

Traffic Speed Data—Addressing Missing Values

Travel time data sets based on vehicles acting as "probes" may have missing values for certain locations and time periods due to gaps in traffic at that place and time. Imputation methods are used by vendors of these data sets to fill in these missing values based on the surrounding data.[6]

Linkages to Other TPM Components	Component B: External Collaboration and Coordination (See TPM Framework) Component C: Data Management

STEP D.1.3	Design and develop data views

Description

After relevant data has been compiled, capabilities for data exploration and visualization can be designed and developed. Data exploration and visualization techniques take sets of individual data records and transform them into a form that facilitates interpretation and analysis. The design of these capabilities should be based on the requirements identified in step D.1.1.

Common data exploration techniques include:

- **Grouping:** organizing data into categories for analysis (e.g., corridors or districts)
- **Filtering:** looking at a subset of the data meeting a specified set of criteria (e.g., run off the road crashes on rural roads involving fatalities)
- **Sorting:** ordering data records based on a specified set of criteria (e.g., sort transit routes by daily ridership)
- **Aggregating:** summarizing groups of records by calculating sums, averages, weighted averages, or minimum or maximum values (e.g., calculating the length-weighted average pavement condition index for Interstate highways in District 1)

[5] *Figure 3.5 Imputation of traffic data* from page 54 of the *Strategic Highway Research Program (SHRP 2) Report S2-L02-RR-2: Guide to Establishing Monitoring Programs for Travel Time Reliability*
[6] Strategic Highway Research Program (SHRP 2). (2009). Report S2-L02-RR-2: Guide to Establishing Monitoring Programs for Travel Time Reliability Washington, DC. http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L02-RR-2.pdf

STEP D.1.3	Design and develop data views
	• **Disaggregating:** viewing individual records that comprise a data subset (e.g., view the individual projects for the current fiscal year that are not on time or on budget) Pivot tables and increasingly sophisticated data analysis features in desktop spreadsheet software can perform many of these functions, as can various other commercially available reporting and business intelligence tools. For some types of visualizations, specialized software development may be required. Work may be needed to prepare the data so that it utilizes common, consistent categories and includes valid data for elements that will be used for grouping, filtering sorting and aggregating. **Common data visualizations include:** • Charts that summarize current performance, trend lines and peer comparisons– these may be bar (simple, stacked, or clustered), line, and pie charts, scatter or bubble charts, bullet graphs, histograms, radar charts, tree maps, heat maps, or combinations. • Maps that show performance by location or network segment, or allow for examination of detailed information such as condition of individual assets or characteristics of individual crashes. Maps are a useful tool for integrating multiple data sets with a spatial component in order to better understand results. They are also useful for communicating performance information to both internal and external audiences. • Dashboards that utilize a variety of charts to show high-level performance indicators. Dashboards may be interactive–enabling drill down from categories to sub-categories and individual records. • Infographics developed to facilitate understanding of a specific performance area. Some agencies have been able to leverage external resources for developing useful data visualizations. They make an open data feed available, and encourage app developers to present the data in useful forms (e.g., interactive maps).
Examples	**Sample Visualizations from Washington State DOT** Washington State DOT's Gray Notebook provides several examples of effective data visualizations. The donut chart displayed in Figure D-4 demonstrates the relative magnitudes of different reasons for cancelling ferry trips. The stamp graphs in Figure D-5 depict differences in congestion, both temporally (by period of the day, and by year) and geographically. The spiral graph in Figure D-6 shows where and when delay is greatest along a corridor. A fourth image shown in Figure D-7 from WSDOT (but not from the Gray Notebook) shows a screenshot of a tool that can be used in the field to review and validate different components of the pavement condition index along a specified road segment.

STEP D.1.3	Design and develop data views

Figure D-4: WSDOT Data Visualization Example 1

Source: The Gray Notebook Volume 58[7]

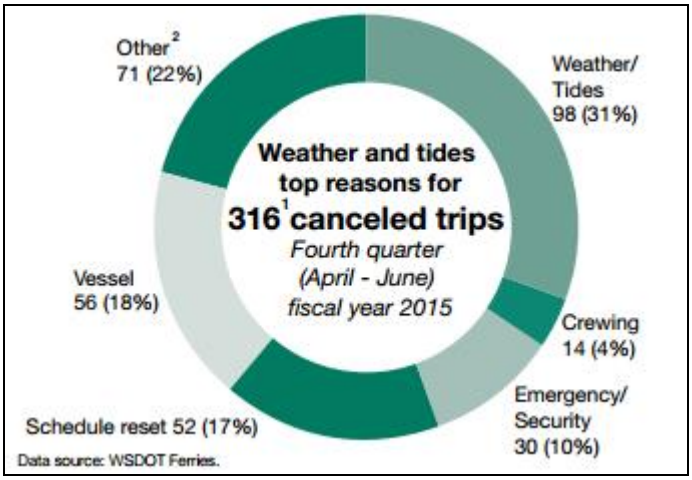
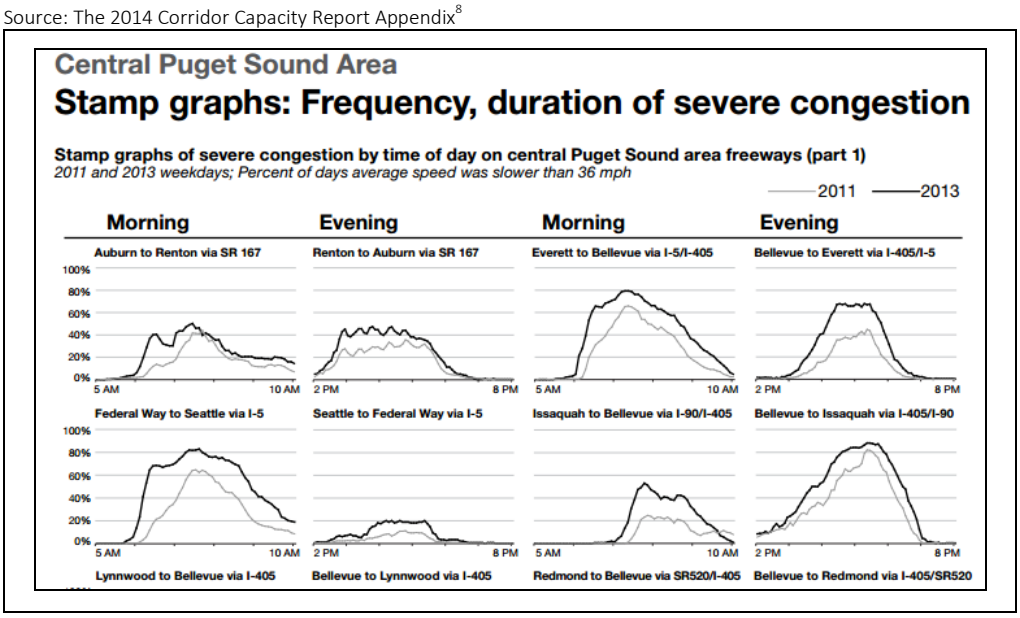


Figure D-5: WSDOT Data Visualization Example 2

Source: The 2014 Corridor Capacity Report Appendix[8]



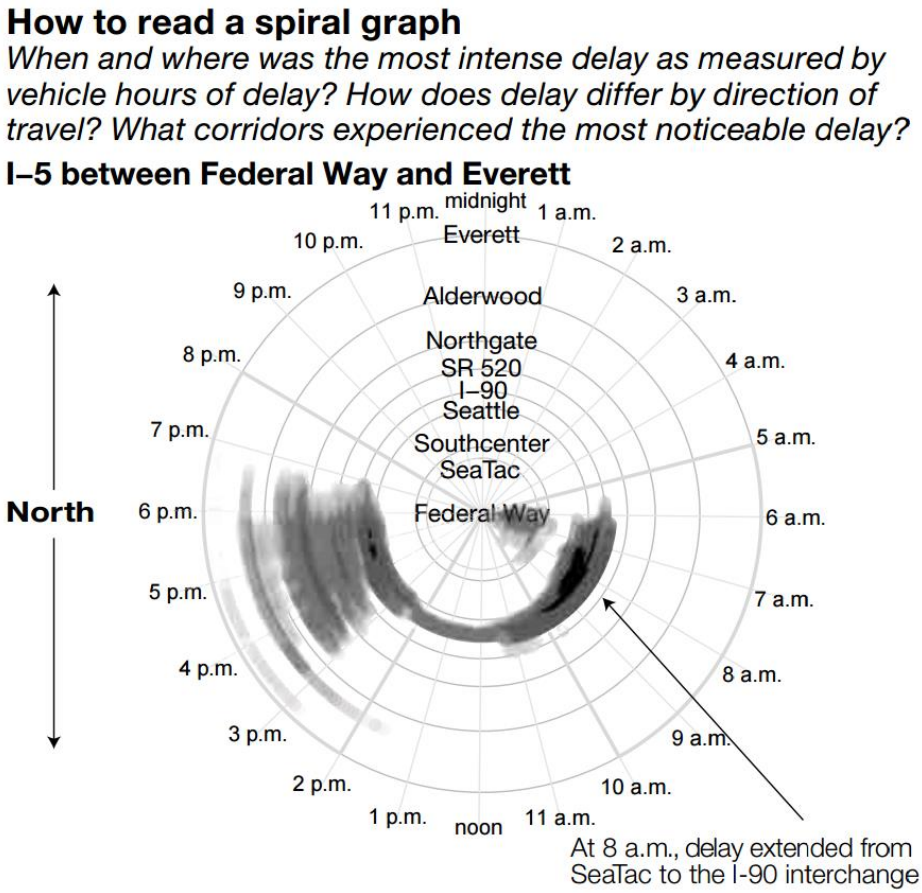
[7] Washington State Department of Transportation. (2015). The Gray Notebook: WSDOT's Quarterly Performance Report on Transportation Systems, Programs, and Department Management (June 30, 2015). Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/Jun15.pdf

[8] Washington State Department of Transportation. (2014). The 2014 Corridor Capacity Report Appendix. Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/CCR14_appendix.pdf#page=8

STEP D.1.3	Design and develop data views

Figure D-6: WSDOT Data Visualization Example 3

Source: The 2014 Corridor Capacity Report Appendix[9]

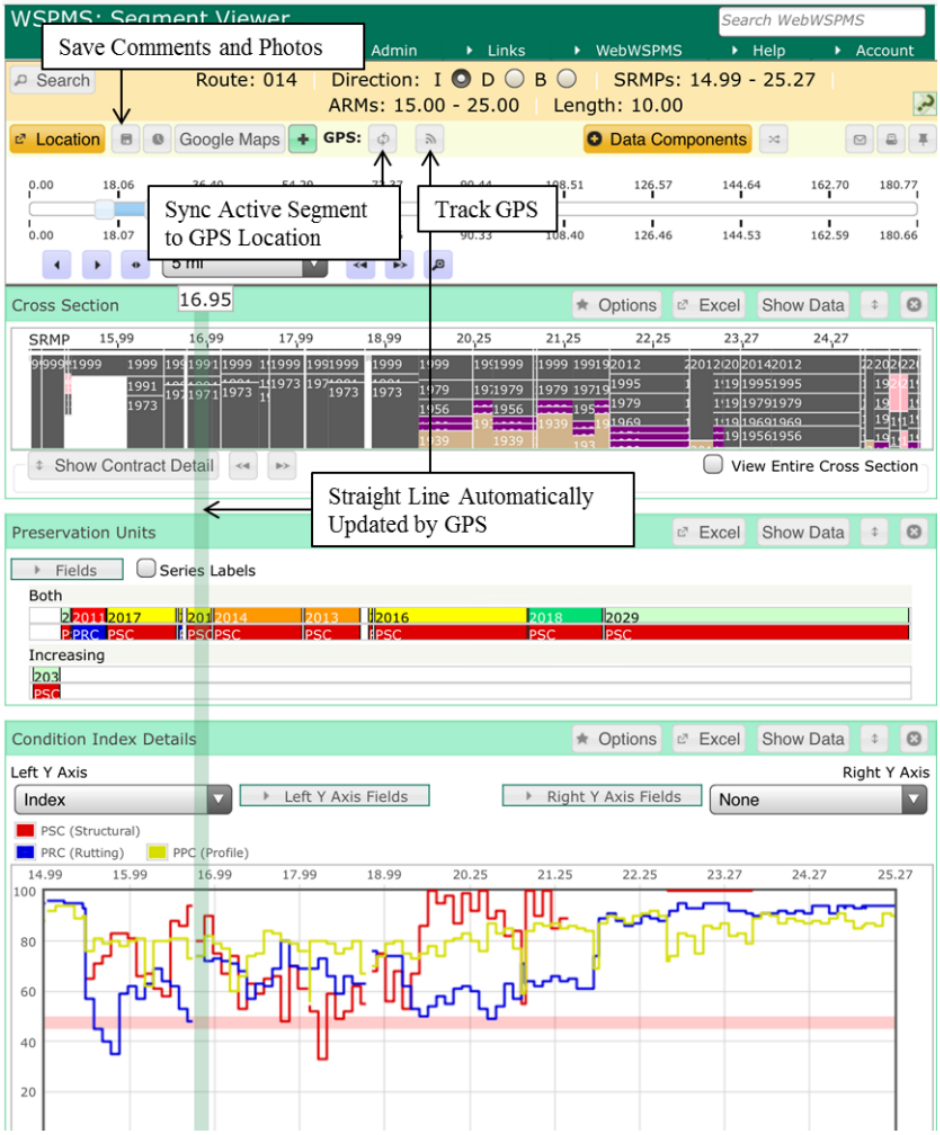


[9] Washington State Department of Transportation. (2014). The 2014 Corridor Capacity Report Appendix. Olympia, WA. http://wsdot.wa.gov/publications/fulltext/graynotebook/CCR14_appendix.pdf#page=10

STEP D.1.3	Design and develop data views

Figure D-7: WSDOT Data Visualization Example 4

Source: Visualizing Pavement Management Data[10]



[10] Washington State Department of Transportation. (2015). Visualizing Pavement Management Data at the Project Level. Olympia, WA. https://www.wsdot.wa.gov/NR/rdonlyres/D77C2653-25AD-4AD3-A0D6-A1B268073E09/0/VisualizingPavementManagmentDataattheProjectLevel.pdf

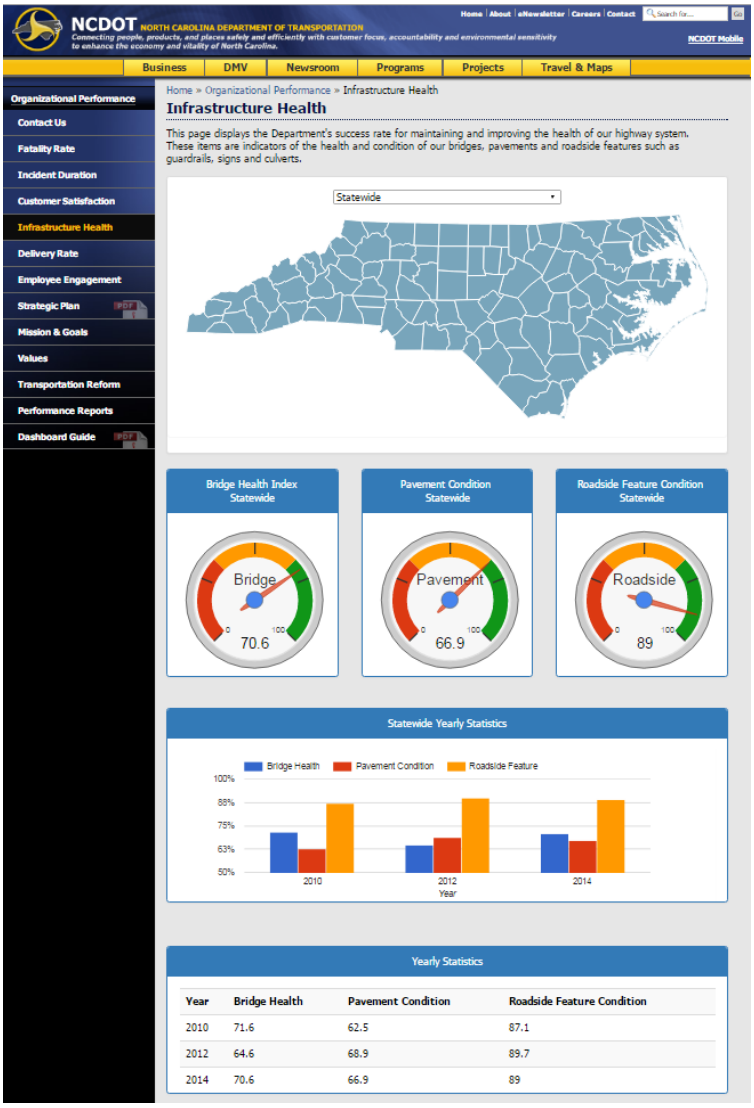
STEP D.1.3	Design and develop data views

Organizational Performance: North Carolina Department of Transportation[11]

North Carolina DOT allows users to quickly compare performance statewide or for specific counties on its website. The example below demonstrates infrastructure health statistics (bridge health index, pavement condition, and roadside feature condition) at the statewide level, but the clickable map allows users to easily explore performance across counties. The data view also displays historical data at the annual level.

Figure D-8: NCDOT Performance Data for Public Consumption

Source: Infrastructure Health[12]



[11] North Carolina Department of Transportation, "Organizational Performance: Infrastructure Health," http://www.ncdot.gov/performance/InfrastructureHealth.html. Retrieved June 6, 2016.
[12] North Carolina Department of Transportation, "Organizational Performance: Infrastructure Health. http://www.ncdot.gov/performance/InfrastructureHealth.html. Retrieved June 6, 2016.

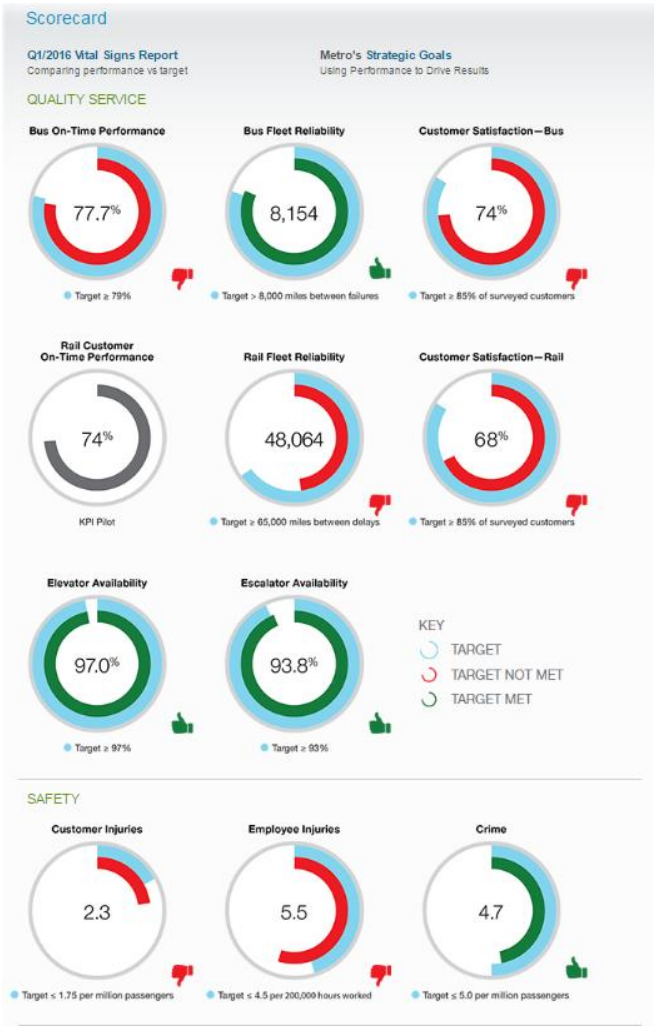
STEP D.1.3	Design and develop data views

Performance Scorecard: Washington Metropolitan Area Transit Authority[13]

Washington Metropolitan Area Transit Authority (WMATA)'s Scorecard dashboard shows high-level performance indicators across a number of categories, displaying a total of 14 performance measures related to service quality, safety, and people and assets. The dashboard displays WMATA's performance in the given period along with the target performance for the period. Indicators are color-coded in green and red so that it is instantly clear to the user whether WMATA met its target for each performance indicator. An accompanying "Vital Signs Report" is available that provides further details on each of the performance indicators, including historical performance, reasons for historical change, and key actions to improve performance.

Figure D-9: WMATA Scorecard Dashboard

Source: WMATA[14]



[13] Washington Metropolitan Area Transit Authority, "Scorecard" (2016 Q1), https://www.wmata.com/about_metro/scorecard/.
[14] Washington Metropolitan Area Transit Authority, "Scorecard" (2016 Q1), https://www.wmata.com/about_metro/scorecard/

STEP D.1.3	Design and develop data views
	37 Billion Mile Data Challenge: Massachusetts Department of Transportation, Metropolitan Area Planning Council, and Massachusetts Technology Collaborative[15] MassDOT, the Metropolitan Area Planning Council (MAPC), and the Massachusetts Technology Collaborative (MassTech) collaborated to hold a data challenge where the agencies provided the public with vehicle census data and asked the public to provide policy insights. The vehicle census data was produced using anonymized State Vehicle Registry data, and included data on vehicle characteristics, annual mileage, and aggregate spatial data. The data challenge encouraged participants to consider specific questions, such as, "What factors make a neighborhood more likely to have high car ownership and mileage," and "Where might investments in walking, biking and transit have the biggest impact in reducing how much people drive"? Award-winning entries included a split-screen mapping tool comparing any two of a set of emissions metrics, visualization tools made available to other entrants, and an infographic on driving facts.
Linkages to Other TPM Components	Component A: Organization and Culture (See TPM Framework) Component C: Data Management

[15] Massachusetts Department of Transportation, "Data Rules the Road: Massachusetts Driving Habits Revealed in Data Challenge" (May 2, 2014), http://www.massdot.state.ma.us/main/tabid/1075/ctl/detail/mid/2937/itemid/432/Data-Rules-the-Road----Massachusetts-Driving-Habits-Revealed-in-Data-Challenge---.aspx.

D.2 PERFORMANCE DIAGNOSTICS

The following subcomponent outlines implementation steps for agencies to develop performance diagnostics capabilities. This process allows an agency to examine performance changes and understand how factors affected performance.

1. Compile supporting data
2. Integrate diagnostics into analysis and reporting processes

> "All truths are easy to understand once they are discovered; the point is to discover them."
>
> - Galileo Galilei

STEP D.2.1	Compile supporting data
Description	The steps described above for subcomponent D.1 should result in identification of additional data that would be helpful for root cause analysis. Much of the data needed for performance diagnostics will already be compiled as part of agency planning and performance data gathering activities (see Component C, Data Management). However, it may or may not be in a form that is useful for analysis. For example, crash records will typically contain a wealth of information for understanding causal factors. However, linking road inventory or incident data to the crash records requires additional effort. In some instances agencies will find that they need to undertake data quality improvement efforts to ensure consistent spatial referencing across crash and inventory data sets, and to ensure that inventory data are available that match the specific time of the crash. It will be important to distinguish causal factors that are within the agency's control from those that are external. While both types of factors should be considered in developing predictive capabilities, agencies will gain the most value through identifying things that they can do to "move the performance needle."
Examples	Examples of explanatory variables for each of the TPM performance areas are identified below. To diagnose performance in each TPM area, it would be necessary to compile data on some or all of the explanatory variables. **Table D-8: Explanatory Variables (Examples)** Source: Federal Highway Administration

TPM Area	Explanatory Variables
General	Socio-economic and travel trends
Bridge Condition	Structure type and design
	Structure age
	Structure maintenance history
	Waterway adequacy
	Traffic loading
	Environment (e.g., salt spray exposure)
Pavement Condition	Pavement type and design

STEP D.2.1	Compile supporting data	
		Pavement age Pavement maintenance history Environmental factors (e.g., freeze-thaw cycles) Traffic loading
	Safety	Socio-economic and land use factors (e.g., population and population density, age distribution, degree of urbanization) Traffic volume and vehicle type mix Weather (e.g., slippery surface, poor visibility) Enforcement Activities (e.g., seat belts, speeding) Roadway capacity and geometrics (e.g., curves, shoulder drop off) Safety hardware (barriers, signage, lighting, etc.) Speed limits Availability of emergency medical facilities and services
	Air Quality	Stationary source emissions Weather patterns Land use/density Modal split Automobile occupancy Traffic volumes Travel speeds Vehicle fleet characteristics Vehicle emissions standards Vehicle inspection programs
	Freight	Business climate/growth patterns Modal options–cost, travel time, reliability Intermodal facilities Shipment patterns/commodity flows Border crossings State regulations Global trends (e.g., containerization)
	System Performance	Capacity Alternative routes and modes Traveler information Signal operations/traffic management systems Demand patterns Incidents Special events

STEP D.2.1	Compile supporting data
Linkages to Other TPM Components	Component 06: Reporting and Communication Component A: Organization and Culture Component C: Data Management (See TPM Framework)

STEP D.2.2	Integrate diagnostics into analysis and reporting processes
Description	Once data are compiled that can provide diagnostic information (see Component C, Data Management), the data must be integrated into the agency's analysis and reporting tools and processes. **Several different approaches to integration can be considered, depending on the nature of the data:** • Direct linkage to the elemental unit of performance–enabling the analyst to "slice and dice" data by causal factors or conduct statistical analysis. Using this method, a value associated with the causal factor is associated with each elemental performance record (e.g., pavement section, bridge, crash, system performance location/time slice, etc.) • Trend data overlays–enabling the analyst to view trend information for the causal factor together with the primary performance trend (e.g., show VMT growth in a corridor along with changes in average speed) • Spatial overlays–enabling the analyst to view data for geographic areas or network links for the causal factors as an overlay on the primary performance data (e.g., overlay climate zones on a map of pavement deterioration) • High level consideration–separate trend or pattern investigation for the causal factor that assists the analyst to draw conclusions about the primary performance data (e.g., understanding shifts in patterns of global trade for understanding changes in freight flows) Each of these approaches implies different processes for data preparation. The direct linkage approach can require a data conversion or mapping exercise where the causal data set has been independently assembled, and identifiers for location, time, event, or asset are not consistent with those used for the primary performance data set. The trend data overlay approach requires that the causal data set and the primary performance data sets cover the same time frame (or overlap sufficiently to provide for meaningful trend comparison). If time units vary (e.g., fiscal versus calendar years), some degree of conversion may be needed. The spatial overlay approach requires at a minimum that both data sets have spatial referencing that can be utilized within the agency's available GIS. However, some level of data processing may be needed to display different data sets for the same set of zones or network sections. For example, if one data set has population by census tract and another has average pavement condition by district, both could be displayed on a map, but a data conversion

STEP D.2.2	Integrate diagnostics into analysis and reporting processes
	process would be required to aggregate the census tract information to be displayed by district. Data standardization and integration is covered in more detail in Data Management (Component C). Once an integration approach is selected and implemented, a repeatable process to support root cause analysis on an ongoing basis can be implemented. This will require effort, but can save future analysts from having to "reinvent the wheel" later on. The results can take the form of automatically generated views, which can be made available to a wider audience beyond the primary data analyst. Regularly obtaining feedback on the value of the data diagnostic views can result in continued improvements.
Examples	**Minnesota Strategic Highway Safety Plan: Focus Area Priorities**[16] The Minnesota Strategic Highway Safety Plan 2014-2019 was intended to reduce traffic-related crashes. It presents a set of focus areas with strategies for improving statewide road safety. In selecting safety strategies, the state begins by reviewing crash data and analyzing for frequency, patterns, and trends across the focus areas, regions, roadway types, and conditions. As a result, diagnostics are integrated into reporting through the Strategic Highway Safety Plan, and impact the selection of strategies to effect change in future performance. For example, the state combined crash data with road design data to determine if road design had any explanatory power in lane departure crashes, and found that rural two-lane roads with high speed limits account for 49% of severe lane departure crashes. This information is useful for development of key strategies such as: "Provide buffer space between opposite travel directions," and "Provide wider shoulders, enhanced pavement markings and chevrons for high-risk curves."

[16] Minnesota DOT. (2015). *Minnesota Strategic Highway Safety Plan, 2014-2019*. http://www.dot.state.mn.us/trafficeng/safety/shsp/Minnesota_SHSP_2014.pdf

STEP D.2.2 | Integrate diagnostics into analysis and reporting processes

Figure D-10: MnDOT Investment Prioritization

Source: Minnesota Strategic Highway Safety Plan[17]

Relationship to Road Parameters

Road design type and speed limit distribution of severe lane departure crashes in **rural** areas

	<30 mph		30 mph		35 mph - 40 mph		45 mph +		All Speed Limits	
Freeway/Ramps	0	0%	2	<1%	0	0%	128	4%	130	4%
Other Divided Highway	0	0%	2	<1%	0	0%	117	4%	119	4%
4-6 Lanes	0	0%	2	<1%	0	0%	15	<1%	17	1%
3-Lane and 5-Lane	0	0%	0	0%	0	0%	7	<1%	7	<1%
2-Lane Roadway	10	<1%	86	3%	35	1%	**1563**	**49%**	1694	53%
One-Way Street	0	0%	1	<1%	0	0%	0	0%	1	<1%
Other	5	<1%	7	<1%	2	<1%	85	3%	99	3%
All Roadways	15	<1%	100	3%	37	1%	1915	60%	2067	65%

Road design type and speed limit distribution of severe lane departure crashes in urban areas

	<30 mph		30 mph		35 mph - 40 mph		45 mph +		All Speed Limits	
Freeway/Ramps	0	0%	7	<1%	6	<1%	150	5%	163	5%
Other Divided Highway	0	0%	6	<1%	24	1%	95	3%	125	4%
4-6 Lanes	0	0%	80	3%	59	2%	49	2%	188	6%
3-Lane and 5-Lane	0	0%	6	<1%	11	<1%	6	<1%	23	1%
2-Lane Roadway	9	<1%	239	7%	64	2%	155	5%	467	14%
One-Way Street	1	<1%	19	1%	1	<1%	1	<1%	22	1%
Other	7	<1%	10	<1%	5	<1%	15	<1%	37	1%
All Roadways	17	1%	367	11%	170	5%	471	15%	1025	32%

65% of Minnesota's severe lane departure crashes occur in rural areas, compared to 32% in urban areas.

2-lane roads with high speed limits (45+ mph) in rural areas account for 49% of severe lane departure crashes; alternatively, 76% (1563 of 2067) of severe lane departure crashes in rural areas occur on 2-lane roadways with high speed limits.

The severe lane departure crashes that occur in urban areas are more distributed among both facility type and speed limit than those in rural areas.

[17] Minnesota Department of Transportation. (2014). Minnesota Highway Safety Plan. St. Paul, MN. http://www.dot.state.mn.us/trafficeng/safety/shsp/Minnesota_SHSP_2014.pdf

STEP D.2.2	Integrate diagnostics into analysis and reporting processes

Minnesota DOT: Crash Mapping Analysis Tool[18]

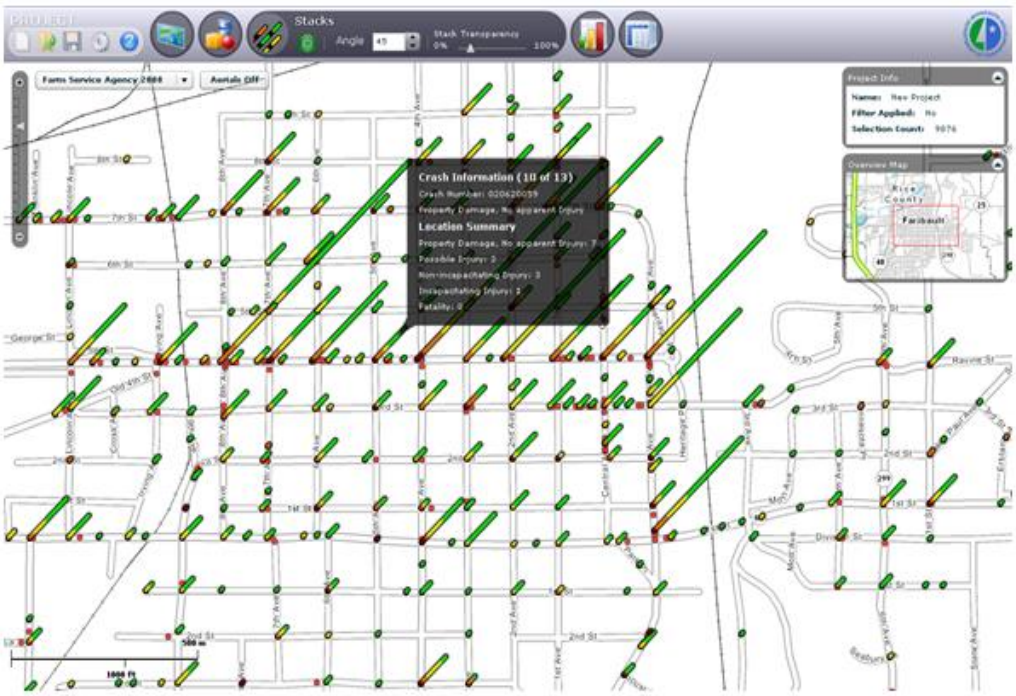
Minnesota DOT also created the Minnesota Crash Mapping Analysis Tool (MnCMAT), which allows approved users to visually examine data compiled and integrated from multiple sources through a GIS-based mapping tool. The MnCMAT has drill down and selection capabilities, and can create various outputs.

The basic analysis process consists of:

1) Selecting the area to be analyzed
2) Applying filtering criteria (e.g., location, contributing factor, time period, crash severity, crash diagram, driver information, road design, speed limit, system class, surface conditions, weather, type of crash, number of fatalities, number of vehicles)
3) Generating output in the form of maps, charts, reports, and date files

Figure D-11: MnDOT Crash Mapping Analysis Tool

Source: Minnesota Crash Mapping Analysis Tool – MnCMAT Material PowerPoint[19]



[18] Vizecky, Mark and Sulmaan Khan, Minnesota Department of Transportation, "Minnesota Crash Mapping Analysis Tool (MnCMAT) & Crash Data" (Feb. 2015). http://www.dot.state.mn.us/stateaid/trafficsafety/mncmat/material.ppt & http://www.dot.state.mn.us/stateaid/crashmapping.html

[19] Minnesota Department of Transportation. (June 2015). Minnesota Crash Mapping Analysis Tool - MnCMAT Material PowerPoint. St. Paul, MN. http://www.dot.state.mn.us/stateaid/crashmapping.html

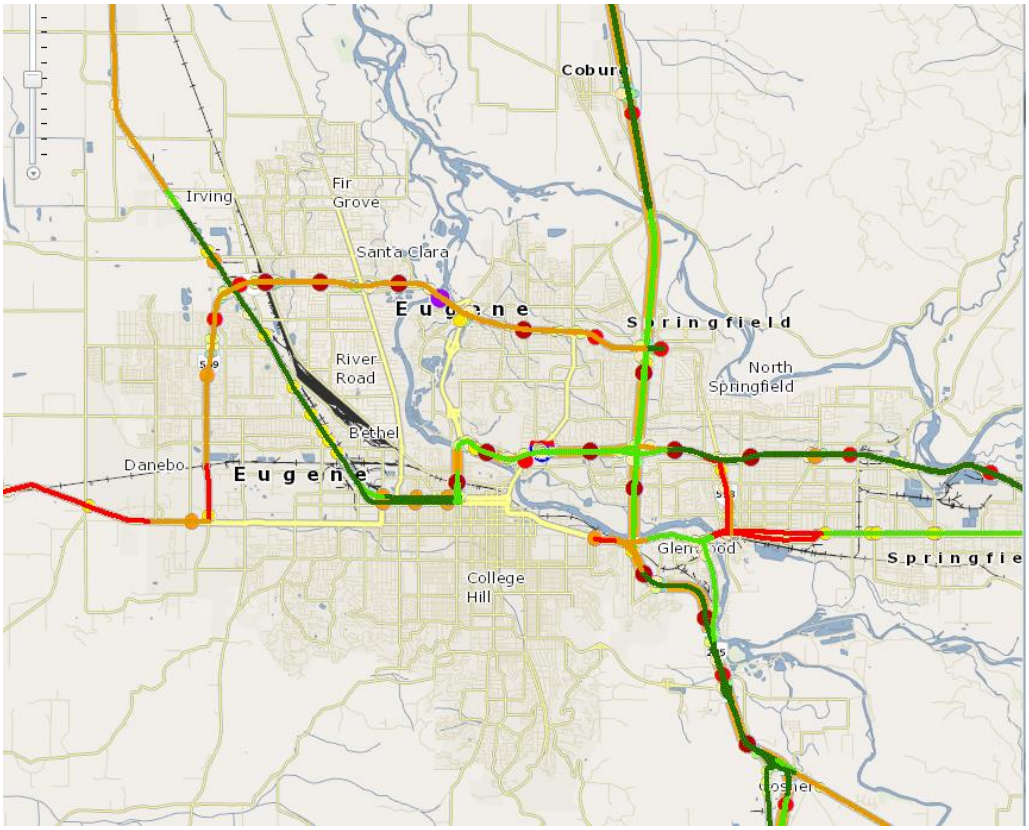
STEP D.2.2	Integrate diagnostics into analysis and reporting processes

Oregon DOT: TransGIS[20]

Oregon DOT's TransGIS web mapping application integrates a variety of data into a user-friendly GIS interface. This enhances the ability for ODOT staff and other users to overlay different data layers to explore and analyze data interrelationships.

Figure D-12: OregonDOT Web Mapping and GIS Integration

Source: ODOT [21]



Linkages to Other TPM Components		
	Component 05: Monitoring and Adjustment	(See TPM Framework)
	Component 06: Reporting and Communication	
	Component A: Organization and Culture	
	Component C: Data Management	

[20] Oregon Department of Transportation, "ODOT TransGIS." https://gis.odot.state.or.us/transgis/ (restricted link).
[21] Oregon Department of Transportation, "ODOT TransGIS." https://gis.odot.state.or.us/transgis/ (restricted link).

D.3 PREDICTIVE CAPABILITIES

Predictive capabilities enable agencies to anticipate future performance and emerging trends. The following section outlines implementation steps for agencies to develop predictive capabilities. Agencies must first establish a methodology for predicting future performance, then evaluate, acquire, and configure analysis tools to support that methodology. Continual review and improvement of tools is an important and ongoing activity.

1. Understand requirements
2. Identify and select tools
3. Implement and enhance capabilities

> "The reality about transportation is that it's future-oriented. If we're planning for what we have, we're behind the curve."
>
> - Anthony Foxx, U.S. Secretary of Transportation

> "The most reliable way to forecast the future is to try to understand the present."
>
> - John Naisbitt, Author of Megatrends

STEP D.3.1	Understand requirements
Description	Predictive capabilities enable agencies to systematically analyze future performance given (1) implementation of performance improvement projects and programs, and (2) changes in other factors that the agency does not control. Performance predictions are useful for setting defensible future performance targets, for planning-level evaluation of the potential effectiveness of alternative strategies to improve performance, and for assessing likely performance impacts of alternative short and mid-range program bundles. Performance predictions can be made at the system-wide, subnetwork, corridor, or facility level. Performance analysis methods can range in complexity–based on the number and type of factors considered, and the technical modeling approach used. A methodology that is intended for network-level predictions is not typically appropriate for site-specific applications. Requirements for performance prediction capabilities can be established by clarifying how these capabilities will be used for target setting, planning, site-specific strategy development, and programming. **In general, predictive capabilities should:** • Allow agencies to analyze the "do nothing" scenario–to predict how performance would change if no improvements were implemented • Allow agencies to estimate the potential impacts of individual strategies for performance improvement • Allow agencies to predict how the value of a performance measure will change based on implementation of plans or programs Ideally, predictive capabilities should allow for convenient testing of a variety of assumptions. A scenario analysis approach to prediction recognizes inherent uncertainties and ensures that recipients of the analysis understand these uncertainties. Prior to establishing requirements, it is a good idea to do some research into the state of the

STEP D.3.1	Understand requirements
	practice in different areas for performance prediction (see step D.3.2). This can help to identify what is possible given available data and tools – and the level of effort required to implement and maintain a modeling capability.
Examples	**Safety Performance Functions (SPF)** have been developed as a simple method for predicting the average number of crashes per year at a location, as a function of exposure and site characteristics. **SPFs can be used in different contexts:** • Network Screening: Identify sites with potential for safety improvement by determining whether the observed safety performance is different from that which would be expected based on data from sites with similar characteristics. • Countermeasure Comparison: Estimate the long-term expected crash frequency without any countermeasures and compare this to the expected frequency with a set of countermeasures under consideration. SPFs can be calibrated to reflect specific locations and time periods. However, an agency may choose to use additional predictive tools to supplement or update SPFs. For further information, see: http://safety.fhwa.dot.gov/tools/crf/resources/cmfs/pullsheet_spf.cfm **Crash Prediction Modeling: Utah Department of Transportation**[22] Utah DOT calibrated the Highway Safety Manual's crash prediction models for statewide curved segments of rural two-lane two-way highways over three-year and five-year periods. The calibration used LiDAR data on highway characteristics in combination with historical crash data. The model incorporated safety performance functions, crash modification factors, and a jurisdictional calibration factor. Utah DOT developed this model to meet requirements for a predictive safety tool that accounts for local conditions and specific roadway attributes.
Linkages to Other TPM Components	Component 02: Target Setting (See TPM Framework) Component 03: Performance-Based Planning Component 04: Performance-Based Programming Component C: Data Management

STEP D.3.2	Identify and select tools
Description	A variety of tools are available for predicting performance. Some tools are simple and don't require specialized software. Others are more complex and can be obtained from FTA, FHWA,

[22] Mitsuru Saito, Casey S. Knecht, Grant G. Schultz, and Aaron A. Cook, "Crash Prediction Modeling for Curved Segments of Rural Two-Lane Two-Way Highways in Utah," UDOT Research Report No. UT-15.12 (October 2015), http://ntl.bts.gov/lib/56000/56800/56825/15.12_Crash_Prediction_Modeling_for_Curved_Segments_of_Rural_Two_Lane_Two_Way_Hwys_in_UT.pdf.

STEP D.3.2	Identify and select tools

peer agencies, or through purchase or licensing of software from commercial entities.

Prior to selection of any tool, agencies should conduct an evaluation that includes the following considerations:

- Match with agency business needs;
- Experience of other agencies with the tool (other client/user references);
- Availability of sufficient data to meet tool requirements;
- Ease of integration with existing systems that may supply inputs;
- Ease of integration with existing agency reporting and mapping tools;
- Availability of technical documentation describing methodology and assumptions;
- Availability of user documentation describing steps for tool application;
- The time and complexity of implementation;
- The ability to customize the tool to the agency, both during implementation and on an ongoing basis;
- Tool acquisition and support costs;
- Likelihood of ongoing support and upgrades; and
- Availability of internal staff resources to understand and productively make use of the tool.

In order to ensure that a tool under consideration meets agency requirements, a pilot application can be pursued. This provides an opportunity to test the tool's capabilities with real data for a limited application.

Examples

Table D-9: Example Analysis Tools and Methods by TPM Performance Area

Source: Federal Highway Administration

TPM Area	Available Tools
Bridge Condition	Bridge Management Systems (commercial, AASHTOWare, and custom built)
Pavement Condition	Pavement Management Systems (commercial and custom built)
Safety	SafetyAnalyst IHDSM Crash Modification Factors See others at: http://safety.fhwa.dot.gov/tsp/fhwasa13033/appxb.cfm
System Performance and Freight	SHRP-2 TravelWorks Bundle Commercial and custom travel demand modeling tools: trip and activity-based (for person travel and freight movement) Traffic Simulation and Analysis Models (see: http://ops.fhwa.dot.gov/trafficanalysistools/ FHWA's Freight Analysis Framework: forecasts Economic Input-Output Models: commercial and custom

STEP D.3.2	Identify and select tools

Freight Demand Modeling: Wisconsin DOT[23,24]

As part of the second Strategic Highway Research Program (SHRP2) Product C20 Implementation Assistance Program, Wisconsin DOT piloted a proof of concept to develop a hybridized model for freight demand, with the goal of integrating it with regional travel demand models in order to quantify the effects of different scenarios on freight transportation in the region. WisDOT is currently reviewing the modeling effort. Outside of the Wisconsin DOT example, the SHRP2 Product C20 as a whole built a strategic plan with a long-term set of strategic objectives for freight demand modeling and data innovation going forward.

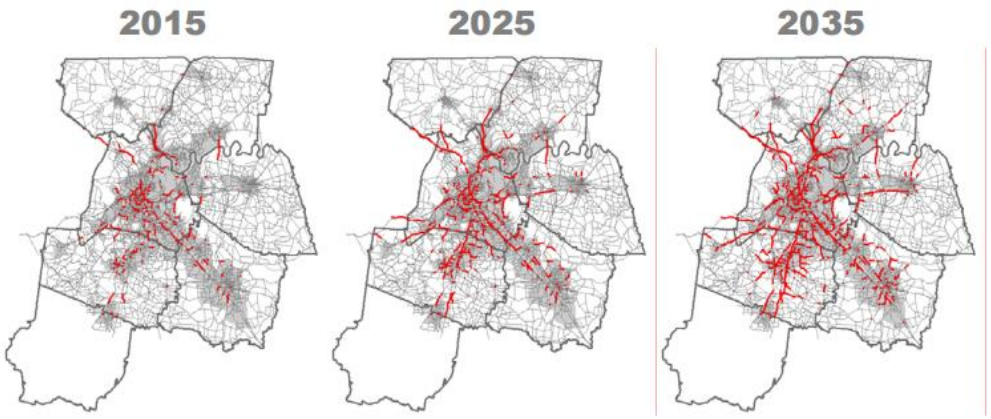
Figure D-13: Integrating Freight Demand Modeling

Source: Transportation Research Board[25]

MPO Congestion Forecasting: Nashville Area MPO[26]

Like many MPOs, the Nashville Area MPO forecasts roadway congestion. The MPO uses a land use model as a tool to predict residential and employment distributions. It then uses a travel demand model as a tool to predict travel patterns. The congestion forecasts then use this travel demand model to identify congested routes in horizon years. The MPO notes that historically, Nashville regional congestion followed a radial commuting pattern into and out of

[23] Federal Highway Administration, "A strategic roadmap for making better freight investments," SHRP2 Project C20. http://www.fhwa.dot.gov/goshrp2/Solutions/All/C20/Freight_Demand_Modeling_and_Data_Improvement
[24] Transportation Research Board. (2013). Freight Demand Modeling and Data Improvement. Washington, DC. http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C20-RR-1.pdf
[25] *Figure 2.1 Innovations Considered in the SHRP 2 C20 Freight Demand Modeling and Data Improvement Strategic Plan* from page 19 of the report, *Strategic Highway Research Program (SHRP 2) Report S2-C20-RR-1: Freight Demand Modeling and Data Improvement*
[26] Nashville Area Metropolitan Planning Organization. (2015). *2035 Nashville Area Regional Transportation Plan*. http://www.nashvillempo.org/docs/lrtp/2035rtp/Docs/2035_Doc/2035Plan_Complete.pdf

STEP D.3.2	Identify and select tools
	downtown CBDs, but that recently congestion has also occurred near suburban commercial clusters (Regional Activity Centers) and in circumferential commuting patterns. This existing scenario serves as a foundation to forecasting future congestion. **Figure D-14: MPO Congestion Forecasting Visualization** Source: Nashville Area MPO[27] 
Linkages to Other TPM Components	Component 03: Performance-Based Planning Component 04: Performance-Based Programming Component 06: Reporting and Communication Component A: Organization and Culture Component C: Data Management (See TPM Framework)

STEP D.3.3	Implement and enhance capabilities
Description	Once the selected predictive tools are in place, an agency can focus on implementing and enhancing its analysis–and integrating use of the tool within agency business processes. This may involve: • Validating and improving model parameters and inputs. Over time, default values for model parameters can be validated and replaced with improved parameters that better match with actual agency experience. • Utilizing the models to analyze risk factors that may impact achievement of strategic goals and objectives. This can be accomplished through scenario analysis that tests the impacts of varying assumptions. • Communicating the value and the limitations of the tools to stakeholders to ensure proper use. Communicating the value can generate support for the tools and future enhancements, while communicating limitations can lead to an understanding of (and possibly support for) how the tool can be approved.

[27] Nashville Area Metropolitan Planning Organization. (2010). 2035 Nashville Area Regional Transportation Plan. Nashville, TN. http://www.nashvillempo.org/docs/lrtp/2035rtp/Docs/2035_Doc/2035Plan_Complete.pdf

STEP D.3.3	Implement and enhance capabilities

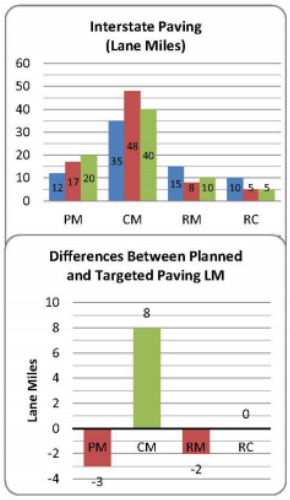
Examples

Pavement Management Analysis: Virginia DOT

Virginia DOT uses a commercial Pavement Management System (PMS) to predict future network-level pavement performance as part of its annual maintenance and operations programming process. The agency sets pavement performance targets at the statewide and district levels. It uses its PMS, together with a companion pavement maintenance scheduling system (PMSS) tool to provide early warning of targets not being reached. This analysis is based on the status of planned paving projects, the most recent pavement condition assessments, and predicted pavement deterioration based on PMS performance models. The pavement management tools allow VDOT to use multi-constraint optimization to predict future needs and performance, and to inform agency business processes (e.g., budgeting and programming). The figure below illustrates one of the reports used to summarize planned versus targeted work by highway system class and treatment type.

Figure D-15: VDOT Comparative Pavement Analysis

Source: Virginia DOT[28]



Hampton Roads Interstate Paving Summary

Preventative Maintenance (PM)

2011 Awarded (PMSS):	16 LM
2012 Planned (PMSS):	17 LM
2012 Targeted (PMS Optimized):	20 LM
Difference (Planned – Targeted):	**-3 LM**

Corrective Maintenance (CM)

2011 Awarded (PMSS):	35 LM
2012 Planned (PMSS):	48 LM
2012 Targeted (PMS Optimized):	40 LM
Difference (Planned – Targeted):	**+8 LM**

Restorative Maintenance (RM)

2011 Awarded (PMSS):	15 LM
2012 Planned (PMSS):	8 LM
2012 Targeted (PMS Optimized):	10 LM
Difference (Planned – Targeted):	**-2 LM**

Reconstruction / Major Rehab (RC)

2011 Awarded (PMSS):	10 LM
2012 Planned (PMSS):	7 LM
2012 Targeted (PMS Optimized):	7 LM
Difference (Planned – Targeted):	**0 LM**

Given planned 2012 Interstate paving, Hampton Roads District:

- **Is not** predicted to achieve its 20 lane mile paving target for Preventative Maintenance on the Interstate system.
- **Is** predicted to achieve its 40 lane mile paving target for Corrective Maintenance on the Interstate system.
- **Is not** predicted to achieve its 10 lane mile paving target for Restorative Maintenance on the Interstate system.
- **Is** predicted to achieve its 7 lane mile paving target for Reconstruction / Major Rehabilitation on the Interstate system.

[28] Virginia Department of Transportation. (2014). Use of VDOT's Pavement Management System to Proactively Plan and Monitor Pavement Maintenance and Rehabilitation Activities to Meet the Agency's Performance Target. Richmond, VA. https://vtechworks.lib.vt.edu/bitstream/handle/10919/56388/ICMPA9-000321.PDF?sequence=2&isAllowed=y)

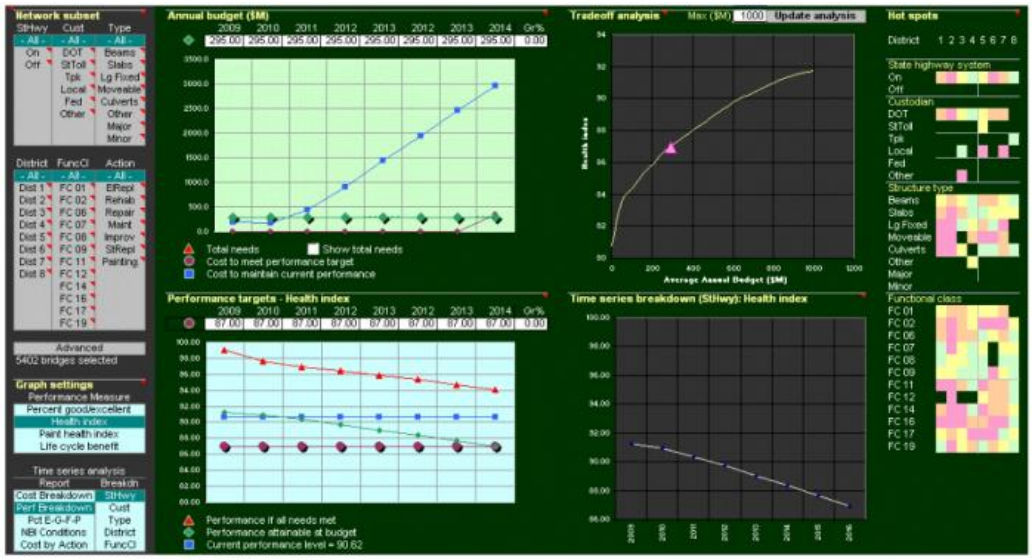
STEP D.3.3	Implement and enhance capabilities

Bridge Management System Enhancements: Florida DOT[29]

Florida DOT implemented the AASHTO Pontis Bridge Management System as part of an effort to improve its asset management information quality, and support decision-making at the network and project levels. Since its initial implementation, Florida DOT has made a number of customized enhancements, such as improving its deterioration and cost models, and implementing multi-objective optimization. Florida DOT uses the outputs of the bridge management system to forecast life cycle costs for planning of maintenance, repair, rehabilitation, and replacement work, and to forecast National Bridge Inventory bridge condition measures. This is helpful for resource allocation, as the software predicts bridge performance levels given different funding scenarios.

Figure D-16: FDOT Pontis Bridge Management System

Source: Florida Department of Transportation[30]



Linkages to Other TPM Components	Component 03: Performance-Based Planning Component 04: Performance-Based Programming Component A: Organization and Culture Component C: Data Management	(See TPM Framework)

[29] Sobanjo, John O. and Paul D. Thompson. (2011). *Final Report: Enhancement of the FDOT's Project Level and Network Level Bridge Management Analysis Tools*. Prepared for Florida Department of Transportation. http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_MNT/FDOT_BDK83_977-01_rpt..pdf

[30] Florida Department of Transportation. (2011). Enhancement of the FDOT's Project Lvel and Network Level Bridge Management Analysis Tools. Tallahassee, FL. http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_MNT/FDOT_BDK83_977-01_rpt..pdf

RESOURCES

General Resources	Year	Link
TPM Toolbox	2016	www.tpmtools.org
AASHTO Asset Management Guide, Volume 2	2013	https://www.fhwa.dot.gov/asset/pubs/hif13047.pdf
NCRHP Report 666: Target Setting Method and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_666.pdf
NCHRP Report 800: Successful Practices in GIS-Based Asset Management	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_800.pdf
NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_814.pdf
Data Systems and Asset Management Including 2014 Thomas B. Deen Distinguished Lecture	2014	http://trrjournalonline.trb.org/toc/trr/2460

Pavement Resources	Year	Link
AASHTO Pavement Management Guide, 2nd Edition	2012	https://bookstore.transportation.org/collection_detail.aspx?ID=117
Pavement Health Track (PHT) Analysis Tool, Summary Report	2013	https://www.fhwa.dot.gov/pavement/healthtrack/pubs/technical/technical.pdf
FHWA Long Term Pavement Performance (LTPP) Website	2015	http://www.fhwa.dot.gov/research/tfhrc/programs/infrastructure/pavements/ltpp/
NCHRP Synthesis 335: Pavement Management Applications Using Geographic Information Systems	2004	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_335.pdf
Database Development for an HMA Pavement Performance Analysis System	2008	http://wisdotresearch.wi.gov/wp-content/uploads/06-13hmadatabase-f.pdf

Bridge Resources	Year	Link
NCHRP Report 590: Multi-Objective Optimization for Bridge Management Systems	2007	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_590.pdf
FHWA Long Term Bridge Performance Website	2015	https://www.fhwa.dot.gov/research/tfhrc/programs/infrastructure/structures/ltbp/

Bridge Resources	Year	Link
Creation of Long-Term Bridge Performance (LTBP) Bridge Portal: A Web-based Application with Advanced Visualization and Analysis Tools		

Safety Resources	Year	Link
Highway Safety Manual, First Edition, with 2014 Supplement	2014	https://bookstore.transportation.org/collection_detail.aspx?ID=135
NCHRP Research Results Digest 329: Highway Safety Manual Data Needs Guide	2008	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_329.pdf
AASHTOWare Safety Analyst Website		http://www.safetyanalyst.org/
Development of a Visualization System for Safety Analyst	2014	http://trrjournalonline.trb.org/doi/10.3141/2460-19
Crash Modification Factors Clearinghouse	2015	http://www.cmfclearinghouse.org/about.cfm
FHWA Highway Safety Information System, Safety Analysis Tools Website	2015	http://www.hsisinfo.org/hsis.cfm?type=6
Exploring Clusters of Contributing Factors for Single-Vehicle Fatal Crashes Through Multiple Correspondence Analysis	2014	http://trid.trb.org/view/1286022

System Performance and Freight Resources	Year	Link
FHWA Traffic Monitoring Guide	2013	https://www.fhwa.dot.gov/policyinformation/tmguide/
FHWA Freight Analysis Framework	2015	http://ops.fhwa.dot.gov/FREIGHT/freight_analysis/faf/index.htm
NCFRP Report 8: Freight Demand Modeling to Support Public Sector Decision Making	2010	http://onlinepubs.trb.org/onlinepubs/ncfrp/ncfrp_rpt_008.pdf
SHRP 2 Report S2-L02-RR-2: Guide to Establishing Monitoring Programs for Travel Time Reliability	2014	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L02-RR-2.pdf
SHRP 2 Report S2-L05-RR-2: Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes	2014	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L05-RR-2.pdf
SHRP 2 Report S2-L04-RR-1: Incorporating Reliability Performance Measures into Operations and Planning Modeling Tools	2014	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L04-RR-1.pdf

System Performance and Freight Resources	Year	Link
SHRP 2, EconWorks Wider Economic Benefits Analysis Tools		https://planningtools.transportation.org/75/analysis-tools.html
SHRP 2 Report S2-C20-RR-1: Freight Demand Modeling and Data Improvement	2013	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C20-RR-1.pdf
Wide-area Congestion Performance Monitoring Using Probe Data	2013	http://trid.trb.org/view/1238533
NCHRP Synthesis 406: Advanced Practices in Travel Forecasting	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_406.pdf
NCHRP Synthesis 384: Forecasting Metropolitan Commercial and Freight Travel	2008	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_384.pdf

ACTION PLAN

1. Of the TPM subcomponents discussed in this chapter, which one would you like to work on?

❑ D.1 Data Exploration and Visualization ❑ D.2 Performance Diagnostics ❑ D.3 Predictive Capabilities

2. What aspect of the TPM process listed above do you want to change?

3. What "steps" discussed in this chapter do you think could help you address the challenge noted above?

Data Exploration and Visualization

- ❑ Understand requirements
- ❑ Assess data usability
- ❑ Design and develop data views

Performance Diagnostics

- ❑ Compile supporting data
- ❑ Integrate diagnostics into analysis and reporting processes

Predictive Capabilities

- ❑ Understand requirements
- ❑ Identify and select tools
- ❑ Implement and enhance capabilities

4. To implement the "step" identified above, what actions are necessary, who will lead the effort and what interrelationships exist?

Action(s)	Lead Staff	Interrelationships

5. What are some potential barriers to success and what solutions did this guidebook provide?

6. Who is someone (internal and/or external) I will collaborate with to implement this action plan?

7. How will I know if I have made progress (milestones/timeframe/measures)?

FIGURE INDEX

TABLE INDEX

APPENDIX A

Agency examples used throughout the guidebook are listed here by component, subcomponent, and step number.

01: Strategic Direction

Subcomponent 1.1 Goals and Objectives

Step	Example
1.1.1: Understand the performance context to create a vision	· Florida DOT · Maryland DOT · North Carolina DOT
1.1.2: Build inclusive internal process to develop goals and objectives	· Universal · FHWA
1.1.3: Engage external stakeholders to refine goals and objectives	· Binghamton Metropolitan Transportation Study (MPO) · Metropolitan Transportation Commission
1.1.4: Evaluate and finalize goals and objectives	· Champaign Urbana Urbanized Area Transportation Study (MPO)
1.1.5: Document the process	· Virginia DOT · Vermont AOT

Subcomponent 1.2 Performance Measures

Step	Example
1.2.1: Inventory data, tools, and performance reports	· District of Columbia DOT
1.2.2: Engage internal staff and external stakeholders	· Maryland DOT
1.2.3: Evaluate potential measures	· Wisconsin DOT · Maricopa Assoc. of Governments
1.2.4: Establish governance process	· Strafford MPO
1.2.5: Document the process	· Washington Metropolitan Area Transit Authority · Minnesota DOT

02: Target Setting

Subcomponent 2.1 Technical Methodology

Step	Example
2.1.1: Establish a baseline	· Universal
2.1.2: Analyze historical trends	· Washington Metropolitan Area Transit Authority
2.1.3: Identify influencing factors and assess risk (internal and external)	· Virginia DOT · Universal
2.1.4: Define target parameters	· Universal

Step	Example
2.1.5: Forecast future performance	· Oregon DOT · Washington State DOT · North Central Texas Council of Governments (MPO) · Rhode Island DOT · MD State Highway Administration
2.1.6: Document technical methodology	· Pennsylvania DOT · Universal

Subcomponent 2.2 Business Process

Step	Example
2.2.1: Assign internal roles and responsibilities	· Universal
2.2.2: Clarify purpose of the target	· Minnesota DOT
2.2.3: Gather information through benchmarking	· NCHRP 20-27 (37) · Missouri DOT · Washington Metropolitan Area Transit Authority
2.2.4: Reflect external stakeholder interests	· Minnesota DOT · Missouri DOT
2.2.5: Document the business process	· AASHTO SCOPM

03: Performance-Based Planning

Subcomponent 3.1 Strategy Identification

Step	Example
3.1.1: Clarify internal and external roles and responsibilities for effective collaboration	· Colorado DOT
3.1.2: Identify key performance issues for each strategic goal and objective	· Pennsylvania DOT
3.1.3: Assess a strategy's effect on outcomes	· Florida DOT
3.1.4: Define and evaluate strategies against desired characteristics	· Arizona DOT
3.1.5: Document strategy identification process	· Metropolitan Transportation Commission

Subcomponent 3.2 Investment Prioritization

Step	Example
3.2.1: Assign internal roles and responsibilities	· Colorado DOT
3.2.2: Develop scenarios to evaluate strategies	· Minnesota DOT
3.2.3: Establish relative importance of strategic goals to guide strategy prioritization	· Washington Metropolitan Area Transit Authority
3.2.4: Document investment prioritization process	· Minnesota DOT

04: Performance-Based Programming

Subcomponent 4.1 Programming Within Performance Areas

Step	Example
4.1.1: Clarify roles of internal staff and external stakeholders	· Arizona DOT
4.1.2: Develop project selection criteria	· Pikes Peak Area COG (MPO)
4.1.3: Establish a formal input process to gather performance-based project information	· Mid-America Regional Council (MPO) · National Capital Region TPB
4.1.4: Document the process	· Atlanta Regional Commission

Subcomponent 4.2 Programming Across Performance Areas

Step	Example
4.2.1: Identify and assign internal roles and responsibilities	· Virginia DOT · Massachusetts DOT · Maryland Transit Administration
4.2.2: Clarify purpose of cross performance area prioritization	· Virginia DOT · Massachusetts DOT · North Carolina DOT · Maryland Transit Administration · Delaware Valley Regional Planning Commission
4.2.3: Develop a methodology that reflects agency priorities and external stakeholder interests	· North Carolina DOT · Virginia DOT · Delaware Valley Regional Planning Commission
4.2.4: Document the process	· North Carolina DOT · Virginia DOT

05: Monitoring & Adjustment

Subcomponent 5.1 System Level

Step	Example
5.1.1: Determine monitoring framework	· Utah DOT
5.1.2: Regularly assess monitoring results	· Regional Transportation Commission (MPO)
5.1.3: Use monitoring information to make adjustments	· Washington Metropolitan Area Transit Authority
5.1.4: Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions	· Colorado DOT
5.1.5: Document the process	· Southwestern PA Commission (MPO) · Missouri DOT

Subcomponent 5.2 Program/Project Level

Step	Example
5.2.1: Determine monitoring framework	· Regional Transportation Commission (MPO) · Nevada DOT

Step	Example
5.2.2: Regularly assess monitoring results	· Rhode Island DOT
5.2.3: Use monitoring information to make adjustments	· Wisconsin DOT · Virginia DOT
5.2.4: Establish an ongoing feedback loop to targets, measures, goals, and future planning and programming decisions	· Montana DOT
5.2.5: Document the process	· Southwestern PA Commission (MPO) · Missouri DOT

06: Reporting and Communication

Subcomponent 6.1 Internal Reporting and Communication

Step	Example
6.1.1: Clarify purpose of the report	· Universal
6.1.2: Define roles and responsibilities	· Tri-County Metropolitan Transp. District of Oregon · Washington State DOT
6.1.3: Develop reporting parameters	· Rhode Island DOT
6.1.4: Refine, automate, and document	· Maricopa Assoc. of Governments

Subcomponent 6.2 External Reporting and Communication

Step	Example
6.2.1: Clarify purpose of the report	· Oregon DOT · Massachusetts DOT · Texas DOT
6.2.2: Define roles and responsibilities	· Minnesota DOT · Wisconsin DOT
6.2.3: Coordinate with external partners	· Washington State DOT · Metropolitan Transportation Commission
6.2.4: Develop reporting parameters	· Washington State DOT · Michigan DOT
6.2.5: Refine, automate, and document	· Missouri DOT · Maricopa Assoc. of Governments · Colorado DOT

A: Organization and Culture

Subcomponent A.1 Leadership Team Support

Step	Example
A.1.1: Evaluate how new agency processes have been implemented previously	· Utah Transit Authority · Rhode Island DOT
A.1.2: Develop TPM pitch	· FHWA

Step	Example
A.1.3: Clarify role of senior and executive management	· Utah DOT · Michigan DOT

Subcomponent A.2 Roles and Responsibilities

Step	Example
A.2.1: Assess current organizational structure	· North Carolina DOT
A.2.2: Define and document TPM roles and responsibilities	· Hampton Roads Transportation Planning Organization · Missouri DOT
A.2.3: Identify and implement changes to organizational structure	· Georgia DOT · Utah DOT · Maricopa Assoc. of Governments

Subcomponent A.3 Training and Workforce Capacity

Step	Example
A.3.1: Identify gaps in employee skillsets	· North Carolina DOT · Ohio DOT
A.3.2: Design, conduct, and refine training program	· Rhode Island DOT
A.3.3: Build agency-wide support for TPM	· Washington State DOT · Caltrans · Texas DOT · Utah Transit Authority · Victoria Transport Policy Institute

Subcomponent A.4 Management Process Integration

Step	Example
A.4.1: Incorporate performance discussions into regular management meetings	· MD Transportation Authority · Tri-County Metropolitan Transp. District of Oregon
A.4.2: Link employee actions to strategic direction	· Washington Metropolitan Transit Authority
A.4.3: Regularly set expectations for employees through measures and targets	· Maryland State Highway Administration · Long Beach Transit

B: External Collaboration and Coordination

Subcomponent B.1 Planning and Programming

Step	Example
B.1.1: Engage with external stakeholders to establish goals, objectives, and measures	· Binghamton Metropolitan Transportation Study (MPO) · Metropolitan Transportation Commission · Maryland DOT
B.1.2: Collaboratively establish targets	· Missouri DOT · Washington State DOT · State of California

Step	Example
B.1.3: Develop and implement strategies in a collaborative manner	· Mid-America Regional Council (MPO) · Massachusetts DOT · Metropolitan Washington COG · MD State Highway Administration · Washington Metropolitan Area Transit Authority

Subcomponent B.2 Monitoring and Reporting

Step	Example
B.2.1: Implement data sharing protocols	· Regional Transportation Commission (MPO) · Nevada DOT · Metropolitan Council · Utah DOT
B.2.2: Review and discuss content of reports to ensure consistent messaging	· AASHTO · Metropolitan Transportation Commission · Washington State DOT
B.2.3: Formalize process for monitoring and reporting	· I-95 Corridor Coalition · New Hampshire DOT · Maine DOT · Vermont AOT

C: Data Management

Subcomponent C.1 Data Quality

Step	Example
C.1.1: Establish data quality requirements and metrics	· FHWA
C.1.2: Create data validation rules	· Virginia DOT
C.1.3: Develop quality management processes	· FHWA · Michigan DOT

Subcomponent C.2 Data Accessibility

Step	Example
C.2.1: Establish requirements for different audiences	· Universal
C.2.2: Enhance data access methods and tools	· Washington State DOT · Minnesota DOT · Utah DOT

Subcomponent C.3 Data Standardization and Integration

Step	Example
C.3.1: Assess data against standards and requirements	· Universal
C.3.2: Create and implement a data integration plan	· Idaho Transportation Department · Oregon DOT

Subcomponent C.4 Data Collection Efficiency

Step	Example
C.4.1: Identify opportunities for data collaboration	· Metropolitan Council · Utah DOT · Wisconsin DOT · Florida DOT · Michigan Asset Management Council

C.5 Data Governance

Step	Example
C.5.1: Define roles and accountability	· Minnesota DOT
C.5.2: Implement governance structures and policies	· Caltrans · Colorado DOT · FHWA

D: Data Usability and Analysis

Subcomponent D.1 Data Exploration and Visualization

Step	Example
D.1.1: Understand requirements	· Utah DOT
D.1.2: Assess data usability	· University of Massachusetts · Universal
D.1.3: Design and develop data views	· Washington State DOT · North Carolina DOT · Washington Metropolitan Area Transit Authority · MassDOT

Subcomponent D.2 Performance Diagnostics

Step	Example
D.2.1: Compile supporting data	· Universal
D.2.2: Integrate diagnostics into analysis and reporting processes	· Minnesota DOT · Oregon DOT

Subcomponent D.3 Predictive Capabilities

Step	Example
D.3.1: Understand requirements	· FHWA · Utah DOT
D.3.2: Identify and select tools	· Wisconsin DOT · Nashville Area MPO
D.3.3: Implement and enhance capabilities	· Virginia DOT · Florida DOT

U.S. Department of Transportation
Federal Highway Administration

APPENDIX B

A comprehensive list of relevant resources is provided here by component. These resources are also listed at the end of each component chapter.

The TPM Toolbox as well as FHWA and FTA materials are important resources across all components:

Resource	Link
TPM Toolbox	www.tpmtools.org
FHWA Transportation Performance Management	http://www.fhwa.dot.gov/tpm/links_fhwa.cfm
FHWA Fact Sheets on Fixing America's Surface Transportation (FAST) Act	https://www.fhwa.dot.gov/fastact/factsheets/
FHWA Fact Sheets on Moving Ahead for Progress in the 21st Century (MAP-21)	https://www.fhwa.dot.gov/map21/factsheets/
FHWA Resources on MAP-21 Rulemaking	https://www.fhwa.dot.gov/tpm/rule.cfm
FHWA TPM Noteworthy Practices	http://www.fhwa.dot.gov/tpm/resources/noteworthy.cfm
FTA Fact Sheets on FAST Act	https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-fast-act
FTA Resources on MAP-21	https://www.transit.dot.gov/regulations-and-guidance/legislation/map-21/map-21-program-fact-sheets

01: Strategic Direction

Resource	Year	Link
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
FHWA Interim Guidance on National Performance Measure Development	2012	http://www.regulations.gov/#!documentDetail;D=FHWA-2013-0020-0016
A Guidebook for Performance-Based Transportation Planning (NCHRP Report 446)	2000	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf
Performance Measurement Framework for Highway Capacity Decision Making (SHRP 2 Report S2-CO2-RR)	2009	http://onlinepubs.trb.org/onlinepubs/shrp2/shrp2_S2-C02-RR.pdf

Resource	Year	Link
Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning	2012	http://www.fhwa.dot.gov/planning/performance_based_planning/mlrtp_guidebook/
Performance Measurement: Getting Results	2006	Book, Harry P. Hatry (author) https://books.google.com/books/about/Performance_Measurement.html?id=PQNUNlwdbDQC

02: Target Setting

General Resources	Year	Link
Target Setting Peer Exchange	2014	https://www.planning.dot.gov/Peer/Arizona/scottsdale_6-17-14_FHWA_target_setting.pdf
Transforming Performance Measurement for the 21st Century	2014	http://www.urban.org/sites/default/files/alfresco/publication-pdfs/413197-Transforming-Performance-Measurement-for-the-st-Century.PDF
SCOPM Task Force Findings on MAP-21 Performance Measure Target-Setting	2013	http://scopm.transportation.org/Documents/SCOPM%20Task%20Force%20Findings%20on%20Performance%20Measure%20Target-Setting%20FINAL%20v2%20(3-25-2013).pdf
Performance-Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
AASHTO SCOPM Target-Setting Workshop	2013	http://sites.spypondpartners.com/targetsetting/workshop/slides/00-notes.pdf
NCHRP Report 666: Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_666.pdf
A Performance Management Framework for State and Local Government	2010	http://www.gfoa.org/sites/default/files/APerformanceManagementFramework.pdf
NCHRP Report 551: Performance Measures and Targets for Transportation Asset Management	2006	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_551.pdf
Transportation Performance Management Awareness (FHWA-NHI Course #138001)		https://www.nhi.fhwa.dot.gov/training/course_search.aspx?tab=0&key=Transportation+Performance+Management&sf=0&course_no=138001
Introduction to Performance Measurement (FHWA-NHI Course #138003)		https://www.nhi.fhwa.dot.gov/training/course_search.aspx?tab=0&key=Transportation+Performance+Management&sf=0&course_no=138003
FHWA Office of Transportation Performance Management	2011	http://www.fhwa.dot.gov/tpm/

Safety Resources	Year	Link
Urbanized and Nonurbanized Safety Target Setting: Final Report	2015	http://safety.fhwa.dot.gov/hsip/tpm/fhwasa15067/
Safety Target Setting Final Report	2013	http://safety.fhwa.dot.gov/hsip/spm/docs/safetyfinalrpt.pdf
A Compendium of State and Regional Safety Target Setting Practices	2013	http://safety.fhwa.dot.gov/hsip/spm/docs/compendium.pdf
Safety Target Setting Peer Exchange	2013	http://safety.fhwa.dot.gov/hsip/spm/docs/peer_exchange.pdf
Performance Management Practices and Methodologies for Setting Safety Performance Targets, Literature Review	2011	http://safety.fhwa.dot.gov/hsip/spm/docs/literature_review.pdf

03: Planning

Resource	Year	Link
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
Model Long-Range Transportation Plans: A Guide for Incorporating Performance-Based Planning	2014	http://www.fhwa.dot.gov/planning/performance_based_planning/mlrtp_guidebook/fhwahep14046.pdf
Integrating Business Processes to Improve Travel Time Reliability	2011	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L01-RR-1.pdf
NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf
Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities	2012	http://www.fhwa.dot.gov/asset/pubs/hif12035.pdf
FHWA Scenario Planning Guidebook	2011	https://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook/guidebook.pdf
PlanWorks	2015	https://fhwaapps.fhwa.dot.gov/planworks/Home

04: Programming

Resource	Year	Link
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/

Resource	Year	Link
NCHRP 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf
Risk-Based Transportation Asset Management: Evaluating Threats, Capitalizing on Opportunities	2012	http://www.fhwa.dot.gov/asset/pubs/hif12035.pdf
FHWA Scenario Planning Guidebook	2011	http://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook/
Defining Cross-Asset Decision Making: A Discussion Paper	2015	http://www.tam-portal.com/wp-content/uploads/2016/01/Cross-Asset-Allocation.pdf
Flexible Funding for Highway and Transit	Ongoing	http://www.fta.dot.gov/grants/12867.html

05: Monitoring and Adjustment

Resource	Year	Link
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
Model Long Range Transportation Plans: A Guide for Incorporating Performance-Based Planning	2014	http://www.fhwa.dot.gov/planning/performance_based_planning/mlrtp_guidebook/fhwahep14046.pdf
Integrating Business Processes to Improve Travel Time Reliability	2011	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L01-RR-1.pdf
NCHRP Report 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf
NCHRP Report 660: Transportation Performance Management: Insight from Practitioners	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf

06: Reporting and Communication

Resource	Year	Link
Communicating Performance	2015	http://communicatingperformance.com/
Performance-Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
FHWA Performance Reporting: Part one of two Final Report	2013	http://www.fhwa.dot.gov/tpm/resources/docs/hif13043.pdf

Resource	Year	Link
The New Language of Mobility	2011	http://downloads.transportation.org/ANewWayToTalkAboutTransportation/NewLanguageofMobility.pdf
A Guidebook for Performance-Based Transportation Planning (NCHRP Report 446)	2000	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf

A: Organization and Culture

Resource	Year	Link
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
NCHRP Report 798: The Role of Planning in a 21st Century State Department of Transportation—Supporting Strategic Decisionmaking	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_798.pdf
NCHRP Report 660: Transportation Performance Management: Insight from Practitioners	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf
A CFO's Handbook on Performance Management	2010	http://www.transportation-finance.org/pdf/0211_performance_management_briefing_paper.pdf

B: External Collaboration

Resource	Year	Link
Performance Based Planning and Programming Guidebook	2013	http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/
Model Long Range Transportation Plans: A Guide for Incorporating Performance-Based Planning	2014	http://www.fhwa.dot.gov/planning/performance_based_planning/mlrtp_guidebook/fhwahep14046.pdf
Integrating Business Processes to Improve Travel Time Reliability	2011	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L01-RR-1.pdf
NCHRP Report 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_806.pdf
NCHRP Report 660: Transportation Performance Management: Insight from Practitioners	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_660.pdf
PlanWorks	2015	https://fhwaapps.fhwa.dot.gov/planworks/Home

Resource	Year	Link
Target Setting Peer Exchange	2014	https://www.planning.dot.gov/Peer/Arizona/scottsdale_6-17-14_FHWA_target_setting.pdf
Communicating Performance	2015	http://communicatingperformance.com/

C: Data Management

Resource	Year	Link
Improving Safety Data Programs Through Data Governance and Data Business Planning	2015	http://onlinepubs.trb.org/onlinepubs/circulars/ec196.pdf
FHWA Traffic Monitoring Guide, Appendix E., Compendium of Quality Control Criteria	2013	http://www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/compendium-data-quality.cfm
How to Develop a Data Management and Sharing Plan	2011	http://www.dcc.ac.uk/resources/how-guides/develop-data-plan
Private Sector Data for Performance Management	2011	http://www.ops.fhwa.dot.gov/publications/fhwahop11029/fhwahop11029.pdf
NCHRP Report 666: Target Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_666.pdf
NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_814.pdf
FHWA Volume 1: Data Governance Primer	2015	http://www.fhwa.dot.gov/datagov/dgpvolume%201.pdf
FHWA Data Integration Primer	2010	http://www.fhwa.dot.gov/asset/dataintegration/if10019/dip00.cfm
NOAA Plan for Increasing Public Access to Research Results	2015	http://docs.lib.noaa.gov/noaa_documents/NOAA_Research_Council/NOAA_PARR_Plan_v5.04.pdf
NASCIO Governance Series	2008 - 2009	http://nascio.org/Portals/0/Publications/Documents/NASCIO-DataGovernance-Part1.pdf http://nascio.org/Portals/0/Publications/Documents/NASCIO-DataGovernancePTII.pdf http://nascio.org/Portals/0/Publications/Documents/NASCIO-DataGovernancePTIII.pdf
FHWA Data Quality White Paper	2008	http://ops.fhwa.dot.gov/publications/fhwahop08038/pdf/dataqual_whitepaper.pdf
FHWA Asset Management Data Collection for Supporting Decision Processes	2006	http://www.fhwa.dot.gov/asset/dataintegration/if08018/assetmgmt_web.pdf
FHWA Traffic Data Quality Measurement	2004	http://ntl.bts.gov/lib/jpodocs/repts_te/14058.htm

Resource	Year	Link
FHWA GIS-T Operating Agreements Page		https://www.gis.fhwa.dot.gov/gdc_agreements.asp
New York State Department of Transportation – NYSGIS Clearinghouse		https://gis.ny.gov/gisdata/inventories/member.cfm?OrganizationID=539
The Data Management Association Data Management Body of Knowledge		http://www.dama.org/content/body-knowledge
International Association for Information and Data Quality		http://iaidq.org/

D: Data Usability and Analysis

General Resources	Year	Link
AASHTO Asset Management Guide, Volume 2	2013	https://www.fhwa.dot.gov/asset/pubs/hif13047.pdf
NCRHP Report 666: Target Setting Method and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_666.pdf
NCHRP Report 814: Data to Support Transportation Agency Business Needs: A Self-Assessment Guide	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_814.pdf
NCHRP Report 800: Successful Practices in GIS-Based Asset Management	2015	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_800.pdf
Data Systems and Asset Management Including 2014 Thomas B. Deen Distinguished Lecture	2014	http://trrjournalonline.trb.org/toc/trr/2460

Pavement Resources	Year	Link
AASHTO Pavement Management Guide, 2nd Edition	2012	https://bookstore.transportation.org/collection_detail.aspx?ID=117
Pavement Health Track (PHT) Analysis Tool, Summary Report	2013	https://www.fhwa.dot.gov/pavement/healthtrack/pubs/technical/technical.pdf
FHWA Long Term Pavement Performance (LTPP) Website	2015	http://www.fhwa.dot.gov/research/tfhrc/programs/infrastructure/pavements/ltpp/
NCHRP Synthesis 335: Pavement Management Applications Using Geographic Information Systems	2004	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_335.pdf
Database Development for an HMA Pavement Performance Analysis System	2008	http://wisdotresearch.wi.gov/wp-content/uploads/06-13hmadatabase-f.pdf

Bridge Resources	Year	Link
NCHRP Report 590: Multi-Objective Optimization for Bridge Management Systems	2007	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_590.pdf
FHWA Long Term Bridge Performance Website	2015	https://www.fhwa.dot.gov/research/tfhrc/programs/infrastructure/structures/ltbp/
Creation of Long-Term Bridge Performance (LTBP) Bridge Portal: A Web-based Application with Advanced Visualization and Analysis Tools		

Safety Resources	Year	Link
Highway Safety Manual, First Edition, with 2014 Supplement	2014	https://bookstore.transportation.org/collection_detail.aspx?ID=135
NCHRP Research Results Digest 329: Highway Safety Manual Data Needs Guide	2008	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_329.pdf
AASHTOWare Safety Analyst Website		http://www.safetyanalyst.org/
Development of a Visualization System for Safety Analyst	2014	http://trrjournalonline.trb.org/doi/10.3141/2460-19
Crash Modification Factors Clearinghouse	2015	http://www.cmfclearinghouse.org/about.cfm
FHWA Highway Safety Information System, Safety Analysis Tools Website	2015	http://www.hsisinfo.org/hsis.cfm?type=6
Exploring Clusters of Contributing Factors for Single-Vehicle Fatal Crashes Through Multiple Correspondence Analysis	2014	http://trid.trb.org/view/1286022

System Performance and Freight Resources	Year	Link
FHWA Traffic Monitoring Guide	2013	https://www.fhwa.dot.gov/policyinformation/tmguide/
FHWA Freight Analysis Framework	2015	http://ops.fhwa.dot.gov/FREIGHT/freight_analysis/faf/index.htm
NCFRP Report 8: Freight Demand Modeling to Support Public Sector Decision Making	2010	http://onlinepubs.trb.org/onlinepubs/ncfrp/ncfrp_rpt_008.pdf
SHRP 2 Report S2-L02-RR-2: Guide to Establishing Monitoring Programs for Travel Time Reliability	2014	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L02-RR-2.pdf
SHRP 2 Report S2-L05-RR-2: Guide to	2014	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2

System Performance and Freight Resources	Year	Link
Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes		-L05-RR-2.pdf
SHRP 2 Report S2-L04-RR-1: Incorporating Reliability Performance Measures into Operations and Planning Modeling Tools	2014	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L04-RR-1.pdf
SHRP 2, EconWorks Wider Economic Benefits Analysis Tools		https://planningtools.transportation.org/75/analysis-tools.html
SHRP 2 Report S2-C20-RR-1: Freight Demand Modeling and Data Improvement	2013	http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-C20-RR-1.pdf
Wide-area Congestion Performance Monitoring Using Probe Data	2013	http://trid.trb.org/view/1238533
NCHRP Synthesis 406: Advanced Practices in Travel Forecasting	2010	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_406.pdf
NCHRP Synthesis 384: Forecasting Metropolitan Commercial and Freight Travel	2008	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_384.pdf

APPENDIX C

TRANSPORTATION PERFORMANCE MANAGEMENT TERMS

A comprehensive list of transportation performance management terms used in the guidebook is provided here in alphabetical order. Terms particularly relevant to each component are included in the Overview of each component chapter. [1]

Common Term	Definition	Example
Activity	Refers to actions taken by transportation agencies, such as projects, related to strategy implementation.	*Paving key locations, adding new guardrail, rehabilitating a bridge, purchasing new buses.*
Adjustment	The alteration of programming, planning, targets, measures, and goals resulting from analysis of information collected.	*The restriping of a construction project to address an observed increase in traffic incidents.*
Baseline	The observed level of performance for a specified performance period from which implementation begins, improvement is judged, or comparison is made.	*2014 fatality rate = 0.83 per 100 million miles of travel.*
Benchmarking	A comparison of two numbers, often historical data, with current numbers or one agency's results against its peer's.	*Assessing an agency's fatality rate by comparing it to that of a peer agency, or to historic fatality rates.*
Change Management	The discipline that guides how we prepare, equip and support individuals to successfully adopt change in order to drive organizational success and outcomes.	***Individual** change management requires understanding how people experience change and what they need to change successfully. **Organizational** change management provides steps and actions to take at the project level to support the hundreds or thousands of individuals who are impacted by a project. **Enterprise** change management is an organizational core competency that provides competitive differentiation and the ability to effectively adapt to the ever-changing world.*

[1] Vision and mission examples are from the Minnesota Department of Transportation (http://www.dot.state.mn.us/vision/); scenario planning definition is from the Federal Highway Administration (FHWA) Scenario Planning Guidebook (http://www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook/).

Common Term	Definition	Example
Collaboration	Efforts to organize people or groups to enable them to work together effectively.	*Establishment of a target setting working group to set common targets in a bi-state urbanized area.*
Coordination	To work with another person or group in order to accomplish a task.	*Undertaking work to set common targets.*
Customer	Users of an agency's services.	*For a transit agency, riders of buses, light rail, and other transit modes. For a DOT, drivers, walkers, bicyclists, and others.*
Data Accessibility	The ease with which agency staff and partners can obtain data needed for transportation performance management.	*One State DOT has three different traffic operations centers that monitor real time travel conditions. However, there are no procedures or systems in place to consolidate data across the centers or summarize it in a useful form for reporting.*
Data Availability	The degree to which data needed for TPM exist at the right level of detail, with sufficient coverage to meet information needs.	*Lack of supply chain data may limit a freight planner's ability to evaluate the effectiveness of alternative strategies for freight mobility improvement.*
Data Change Management	Processes to coordinate and communicate changes to data definitions, data structures and associated information systems. Change management processes are aimed at minimizing impacts to users and reducing change-related errors.	*A change to the definition of bridge elements requires evaluation to determine and plan for impacts on performance of inspections, calculation of bridge condition indices, identification of rehabilitation strategies, and data structures and software supporting bridge inspection and management processes.*
Data Exploration and Visualization	Presentation of data in a graphical form to enable interactive analysis and facilitate understanding and communication.	*Common TPM data visualizations include maps showing highway links with poor performance, trend lines showing average crash rates, and dashboards showing charts with key performance indicators.*
Data Governance	Establishment of decision rights and accountability with respect to data. For example, who is accountable for data quality and how decisions about sharing data, investing in new data, or improving existing data are made.	*A State DOTs information governance body defined a set of data policies that emphasize data as a shared agency asset and designated data stewards with responsibility for each category of data.*

Common Term	Definition	Example
Data Integration	Combining data that reside in different locations to present a unified view. Data may be integrated into a single physical repository. Alternatively, data may be integrated "virtually" without creation of a new physical data repository.	*The DOT established a data warehouse to provide an integrated view of capital projects, including current status, assets, funding sources, and costs to date.*
Data Quality	The degree to which data are suitable for a given use, considering consistency with requirements and established business rules, accuracy, completeness, and currency or timeliness.	*Lack of timely crash data challenges a safety planner's ability to address emerging safety issues.*
Data Standardization	Practices to ensure different data sets adhere to established standards–which may pertain to inclusion of certain attributes, the definition and meaning of data attributes, their specific format, measurement or quality specifications, allowable values, etc.	*Use of a standard linear referencing system (LRS) enables an agency to display data about traffic, crashes, and various highway features on the same map.*
Data Usability	The ease with which user information needs can be met with available data, tools, and skills.	*A data feed of highway travel speeds is not usable in its raw form. Data processing, summarization and presentation are required to make this data feed usable.*
Data Validation	Process that uses specified criteria to determine whether data are correct, complete and meaningful.	*Validation routines are run on pavement condition data to check for out-of-range condition measures and distresses that are not compatible with the recorded pavement type.*
Goal	A broad statement of a desired end condition or outcome; a unique piece of the agency's vision.	*A safe transportation system.*
Imputation	Substitution of estimated values for missing or inconsistent data element values.	*A probe data set consisting of speeds by five-minute period for each section of an Interstate may have missing data due to insufficient observations for some periods/sections. Data for these periods/sections may be imputed based on values for nearby sections.*
Metric	An indicator of performance or condition.	*The annual number of fatalities.*

Common Term	Definition	Example
Mission	Statement that reflects the core functional purpose of an agency.	*Plan, build, operate and maintain a safe, accessible, efficient and reliable multimodal transportation system that connects people to destinations and markets throughout the state, regionally and around the world.*
Monitoring	The identification and diagnosis of performance systems and programs.	*Freeway and Arterial System of Transportation (FAST), a real-time traffic condition dashboard that enables detailed analysis on request.*
Objective	A specific, measurable statement that supports achievement of a goal.	*Reduce the number of motor vehicle fatalities.*
Outcome	Results or impacts of a particular activity that are of most interest to system users. Focus of subcomponent 5.1 System Level Monitoring and Adjustment.	*Transit travel time reliability, fatality rate, percent of assets within useful life.*
Output	Quantity of activity delivered through a project or program. Focus of subcomponent 5.2 Program/Project Level Monitoring and Adjustment.	*Miles of pavement repaved, miles of new guardrail put into place, the number of bridges rehabilitated, the number of new buses purchased.*
Partner	An organization involved in administering the transportation programs and policies, whether directly or indirectly. Involvement includes, but is not limited to, target setting, planning, programming, monitoring, and reporting.	*Transportation agencies, emergency personnel, chambers of commerce, local government.*
Performance Diagnostics	Analysis of root causes for performance results.	*Correlating traffic incidents with travel speed data; breaking down crash data by contributing factors recorded in crash records or highway inventories.*
Performance Measure	Performances measures are based on a metric that is used to track progress toward goals, objectives, and achievement of established targets. They should be manageable, sustainable, and based on collaboration with partners. Measures provide an effective basis for evaluating strategies for performance improvement.	*Transit passenger trips per revenue hour.*
Performance Period	An established timeframe for monitoring results and collecting data and information for performance reporting.	*A calendar year.*

Common Term	Definition	Example
Program	A program is a document which matches funding to projects.	*A State Transportation Improvement Program (STIP).*
Project Selection Criteria	Evaluation metrics used to rank projects.	*Numerical weights assigned to goals such as economic impact or environmental effects.*
Reporting	Summary documentation of performance trends for either internal or external audiences.	*WSDOT Gray Notebook.*
Risk	Threats to and opportunities for achieving strategies, goals, and targets.	*An extreme weather event causes unanticipated costs.*
Scenario	Scenarios use funding and performance data to determine likely future outcomes.	*An investment of five % more revenue may reduce SD bridges by 10%.*
Scenario Planning	A technique designed to help citizens and stakeholders understand how changes in various forces potentially impact transportation networks in an area.	*Engaging the public in a workshop to compare and contrast the impact of land use scenarios on traffic volumes and distribution.*
Source System of Record	The designated authoritative source system for a given type of data. A single source system is designated to avoid a situation in which multiple versions of a data set are being updated independently and not kept in sync.	*The agency's traffic monitoring system is the source system of record for annual average daily traffic (AADT) data.*
Stakeholder	Person or group affected by, or who believe themselves to be affected by, a transportation agency's activities. This includes, but is not limited to, customers and partners.	*In developing the long-range transportation plan, agencies must engage the general public and representatives of system users such as bicyclists, freight shippers, and public transportation riders.*
Strategy	A well-defined pathway toward reaching a target, goal, or objective.	*Increasing bridge inspections to decrease % falling into SD category.*
Sub-Measure	A detailed quantifiable indicator uncovered during monitoring that provides additional insights into internal and external processes.	*Preventive maintenance compliance—a driver of overall asset performance.*
Target	Level of performance that is desired to be achieved within a specific time frame.	Two % reduction in the fatality rate in the next calendar year.
Transportation Performance Management	A strategic approach that uses system information to make investment and policy decisions to achieve performance goals.	*Determining what results are to be pursued and using information from past performance levels and forecasted conditions to guide investments.*

Common Term	Definition	Example
Trend Line	A trend distilled from historical or projected performance data.	*The graph depicting annual fatality rate and five-year average fatality rate from 2000 to 2014.*
Vision Statement	An overarching statement of desired outcomes that is concisely written, but broad in scope; a vision statement is intended to be compelling and inspiring.	*Minnesota's multimodal transportation system maximizes the health of people, the environment, and our economy.*
Visioning	The process of setting or confirming goals and objectives.	*Envisioning the characteristics of a transit agency providing equitable, efficient, and dependable service.*

COMPONENT DEFINITIONS

Definitions for each component are provided below; subcomponent definitions are contained in guidebook chapters.

Component 01. Strategic Direction

Definition: The establishment of an agency's focus through well-defined goals and objectives, enabling assessment of the agency's progress toward meeting goals and objectives by specifying a set of aligned performance measures. The Strategic Direction is the foundation upon which all transportation performance management rests.

Component 02. Target Setting

Definition: The use of baseline data, information on possible strategies, resource constraints, and forecasting tools to collaboratively establish a quantifiable level of performance the agency wants to achieve within a specific time frame. Targets make the link between investment decisions and performance expectations transparent across all stakeholders.

Component 03. Performance-Based Planning

Definition: The use of agency goals and objectives and performance trends to drive the development of strategies and priorities in the long-range transportation plan and other performance-based plans and processes. The resulting planning documents become the blueprint for how an agency intends to achieve its desired performance outcomes.

Component 04. Performance-Based Programming

Definition: The use of strategies and priorities to guide the allocation of resources to projects that are selected to achieve goals, objectives, and targets. Performance-based programming establishes clear linkages between investments made and expected performance outputs and outcomes.

Component 05. Monitoring and Adjustment

Definition: A set of processes used to track and evaluate actions taken and outcomes achieved, thereby establishing a feedback loop to refine planning, programming, and target setting decisions. It involves using performance data to obtain key insights into the effectiveness of decisions and identifying where adjustments need to be made in order to improve performance.

Component 06. Reporting and Communication

Definition: The products, techniques, and processes used to communicate performance information to different audiences for maximum impact. Reporting is an important element for increasing accountability and transparency to external stakeholders and for explaining internally how transportation performance management is driving a data-driven approach to decision making.

Component A. Performance Management Organization and Culture

Definition: Institutionalization of a transportation performance management culture within the organization, as evidenced by leadership support, employee buy-in, and embedded organizational structures and processes that support transportation performance management.

Component B. External Collaboration and Coordination

Definition: Established processes to collaborate and coordinate with agency partners and stakeholders on planning/visioning, target setting, programming, data sharing, and reporting. External collaboration allows agencies to leverage partner resources and capabilities, as well as increase understanding of how activities impact and are impacted by external factors.

Component C. Data Management

Definition: A set of coordinated activities for maximizing the value of data to an organization. It includes data collection, creation, processing, storage, backup, organization, documentation, protection, integration, dissemination, archiving, and disposal. Well-managed data are essential for a robust TPM practice.

Component D. Data Usability and Analysis

Definition: Existence of useful and valuable data sets and analysis capabilities available in accessible, convenient forms to support transportation performance management. While many agencies have a wealth of data, such data are often disorganized, or cannot be analyzed effectively to produce useful information to support target setting, decision making, monitoring, or other TPM practices.