

2nd
EDITION

AASHTO Transportation Asset Management Guide

A FOCUS ON IMPLEMENTATION

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Table of Contents

Chapter 1. Introduction	1-1
TAM Basics	1-4
What Is TAM?	1-5
Definitions	1-6
TAM Principles	1-8
TAM Elements	1-10
<i>Basic Requirements Checklist</i>	1-12
About This Guide	1-13
Scope and Organization	1-14
Intended Audiences: Who Should Use This Guide?	1-17
Ways to Use This Guide	1-18
TAM Resources	1-20
Frameworks and Guidance	1-21
Legislation and Regulations	1-24
Assessment Tools and Maturity Models	1-25
Communities	1-26
Chapter 1. References	1-28
 Chapter 2. TAM Strategy and Planning	 2-1
Developing a TAM Strategy	2-4
Integrating TAM within Agency Strategic Plans and Policies	2-5
Creating a TAM Policy	2-6
<i>Develop an Asset Management Policy</i>	2-10
TAM Integration	2-12
Planning and Programming	2-13
Performance Management	2-15
Risk Management	2-19
<i>Develop a Risk Register</i>	2-22
Information Management	2-24
TAM Assessment and Advancement	2-27
Assessing Current Practice	2-28
Defining and Prioritizing Improvement in TAM Approaches	2-31
<i>Prioritize Assets for TAM Advancement</i>	2-33
Developing a TAM Implementation Plan	2-34
Monitoring TAM Program Improvements	2-38
Developing a Transportation Asset Management Plan (TAMP)	2-40
The Basic TAMP	2-41
Beyond the Basic TAMP	2-44
Chapter 2. Maturity Scale	2-46
Chapter 2. References	2-47

Chapter 3. Organization and People	3-1
Establishing TAM Roles, Responsibilities, and Competencies	3-4
Organizational Models	3-5
TAM Roles	3-11
<i>TAM Roles</i>	3-16
Competencies	3-17
<i>Recruit Individuals for Asset Management Roles</i>	3-19
Strengthening Coordination and Communication	3-20
Internal Coordination	3-21
<i>Establish a TAM Steering Committee</i>	3-23
External Coordination	3-24
Communication	3-26
<i>Develop a Communications Plan</i>	3-30
Managing Change	3-32
TAM Culture	3-33
Understanding the Organization	3-34
TAM Change Readiness	3-37
<i>Assessing an Organization's Change Readiness</i>	3-39
<i>Manage Change and Prepare for a System Replacement</i>	3-40
Chapter 3. Maturity Scale	3-42
Chapter 3. References	3-44
 Chapter 4. Asset Performance	 4-1
Introduction to Life-Cycle Management	4-4
Defining Life-Cycle Management	4-5
Defining Asset Service and Performance Levels	4-10
<i>Establish Customer-Based, Service-Level Targets</i>	4-15
Developing Life-Cycle Strategies	4-18
Common Life-Cycle Management Approaches for Transportation Assets	4-22
Life-Cycle Management Approaches	4-23
Selecting the Right Management Approach	4-25
Managing Assets over Their Life Cycles	4-28
Managing Assets Using Condition-Based Management	4-29
<i>Life-Cycle Planning for Pavements</i>	4-35
Applying Other Life-Cycle Management Approaches	4-36
Implementing Life-Cycle Management	4-39
<i>Determining What Data Is Needed to Support Life-Cycle Management</i>	4-43
<i>Considerations to Support the Successful Implementation of a Life-Cycle Approach to Managing Assets</i>	4-46
Chapter 4. Maturity Scale	4-48
Chapter 4. References	4-50

Chapter 5. Resource Allocation	5-1
Resource Allocation and Prioritization	5-4
What Is Resource Allocation?	5-5
Transportation Agency Context	5-6
Prototypical Resource Allocation Process	5-8
Consideration of Risk in Resource Allocation	5-13
Cross-Asset Resource Allocation	5-17
Challenges in Cross-Asset Resource Allocation	5-18
Use of Performance Targets to Support Cross-Asset Resource Allocation	5-20
Use of Multi-Objective Decision Analysis for Resource Allocation	5-23
<i>Implementing a Multi-Objective Decision Analysis (MODA) Approach</i>	5-25
<i>Considerations in Implementing a Multi-Objective Allocation Approach</i>	5-26
Financial Planning	5-29
TAM Financial Plan	5-30
Implications for Resource Allocation	5-32
<i>Preparing a TAM Financial Plan</i>	5-34
Work Planning and Delivery	5-36
TAM Work Planning and Delivery	5-37
Implications for Resource Allocation	5-39
<i>Work Planning and Delivery</i>	5-41
Chapter 5. Maturity Scale	5-42
Chapter 5. References	5-43
 Chapter 6. Monitoring and Adjustment	 6-1
Monitoring Performance Measures	6-4
Selecting and Using Performance Measures	6-5
<i>Characteristics of Strong Performance Measures for Managing the Condition of Ancillary Assets</i>	6-14
Evaluating the Effectiveness of Performance Measures	6-15
<i>Benchmark Performance</i>	6-18
Monitoring the State of Assets	6-19
Types of Performance-Based Data to Monitor	6-20
Maintaining Asset Data	6-22
Monitoring Funding and Resource Allocation Trends	6-23
Types of Funding and Resource Allocation Trends	6-24
Using Trend Data to Make Program Adjustments	6-27
Monitoring Asset Work and Costs	6-30
Importance of Tracking Work Activities and Treatment Costs	6-31
Establishing Business Processes to Support Work History and Cost Tracking	6-33
Using Work History Data to Improve Models	6-34
Monitoring Risks and TAM Processes	6-38
Monitoring and Managing Risks	6-39

<i>Monitoring External Risks</i>	6-41
Monitoring TAM Processes and Improvements	6-42
Managing Implementation Responsibilities and Processes	6-44
<i>Risk Management Process</i>	6-49
<i>Use RACI to Create a Responsibility Assignment</i>	6-50
Chapter 6. Maturity Scale	6-51
Chapter 6. References	6-53
 Chapter 7. Information and Systems	 7-1
TAM Information Integration	7-4
TAM Data and Systems	7-5
Why Integrate?	7-10
Planning for TAM Information Integration	7-12
<i>Data Items to Standardize for TAM</i>	7-16
Integrating Asset Information Across the Life Cycle	7-17
Collecting Asset Data	7-19
Deciding What Data to Collect	7-20
How to Collect Data	7-23
Preparing for Data Collection	7-25
<i>Asset Data Collection Readiness Checklist</i>	7-27
Asset Data Sharing, Reporting, and Visualization	7-29
Designing Effective Reports and Visualizations	7-30
Data Sharing	7-33
Preparing Data for Sharing, Reporting, and Visualization	7-36
Data Governance and Management	7-38
Fundamental Concepts and Principles	7-39
Data Governance Practices Supporting TAM	7-41
Assessing Data Management and Governance Maturity	7-43
Chapter 7. Maturity Scale	7-47
Chapter 7. References	7-48



Section 1.1

TAM Basics



Section 1.2

About This Guide



Section 1.3

TAM Resources



Chapter 1

Introduction



Documents

Document Sharing Hub

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Section 1.1

TAM Basics

covers the definitions used throughout the guide and discusses the high-level principles, elements, and benefits of good TAM practice.



Section 1.2

About This Guide

provides an overview of the organization and features of the guide.



Section 1.3

TAM Resources

provides a brief summary of the resources used throughout the guide and indicates how to access the resources.



Chapter 1

Introduction

Welcome to the Transportation Asset Management (TAM) Guide. Whether you are new to asset management, a seasoned practitioner or an executive, this guide will help to further your understanding of asset management techniques and advance asset management practices at your agency.

TAM is a way of conducting a transportation agency's business to deliver more value in its activities so that the transportation system performs best with the available resources. Most agencies have elements of TAM principles in their existing practice. This guide can help with formalizing TAM practice, identifying areas for improvement, and understanding how to improve. Some of the benefits of TAM include:

- **Improved asset condition, performance, resilience, and longevity.** Asset management involves maintaining the asset condition over the asset's lifetime. Improved condition results in improved performance and ultimately extends the life of an asset compared to the alternative of continually deferring maintenance.
- **Improved accountability.** When asset management practices are embedded in an agency, staff are held accountable within the agency and to customers and stakeholders to follow TAM practices and consistently maintain the assets in a state of good repair. Preparing an asset management plan also ensures accountability by providing reliable information about the condition of assets.

- **Increased efficiency and effectiveness.** When assets are managed following an agreed-upon management strategy, efficiency and effectiveness are improved. Regular maintenance can be planned and scheduled, reducing disruption to service as little as possible.
- **More benefit for each dollar invested.** Transportation assets cost money to build, maintain, operate, and use. By stressing the importance of life-cycle planning and costs and placing agreed levels of service at the core of the asset management process, TAM helps to ensure that the benefits delivered by the network are maximized, while the costs of providing, maintaining, and using it are minimized.
- **Reduced risk exposure.** When assets are maintained and managed consistently and resilience is improved, the agency reduces the exposure to risk.
- **Improved coordination and efficiency.** Asset management helps potential silos within an agency by improving resource allocation and improving coordination among staff on asset management related projects and maintenance.



Documents

Document Sharing Hub

Section 1.1

TAM Basics

For those new to asset management, this section is the place to start. In order to provide a solid foundation in asset management, this section provides definitions for key terms used throughout the guide, and describes the principles of TAM, the elements of good TAM practice, and the benefits of asset management.

This section has four parts:

1. **What is TAM?** This definition and overview of TAM provides context and background on asset management and its place within transportation agencies.
2. **Definitions.** Key terms that are used throughout the guide.
3. **TAM Principles.** A summary of the key principles of TAM.
4. **TAM Elements.** A summary of the key elements involved in TAM.

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What Is TAM?

TAM is a “strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their life cycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based on quality information and well-defined objectives.”

TAM is important because of the size and value of the infrastructure that has been built. The total value of the existing inventory of U.S. transportation assets is staggering; based on data from FHWA Highway Statistics, the replacement value of U.S. bridges and pavement alone is over \$5 trillion. TAM offers a set of tools and techniques applicable to sustaining the condition and performance of the full range of transportation assets.

TAM has been a focus area for DOTs in the U.S. for over 15 years, paralleling similar efforts to improve asset management in infrastructure-intensive industries in the U.S. and abroad. Over this period, transportation agencies have worked to increase their understanding of the value and performance of existing assets and implement improved asset management systems and approaches.

This guidance responds to the new challenges that have emerged since TAM was first recognized as a critical area in the U.S. transportation community such as evolving business practices, technology advancements, constrained funding, changing environment, and legislative requirements.

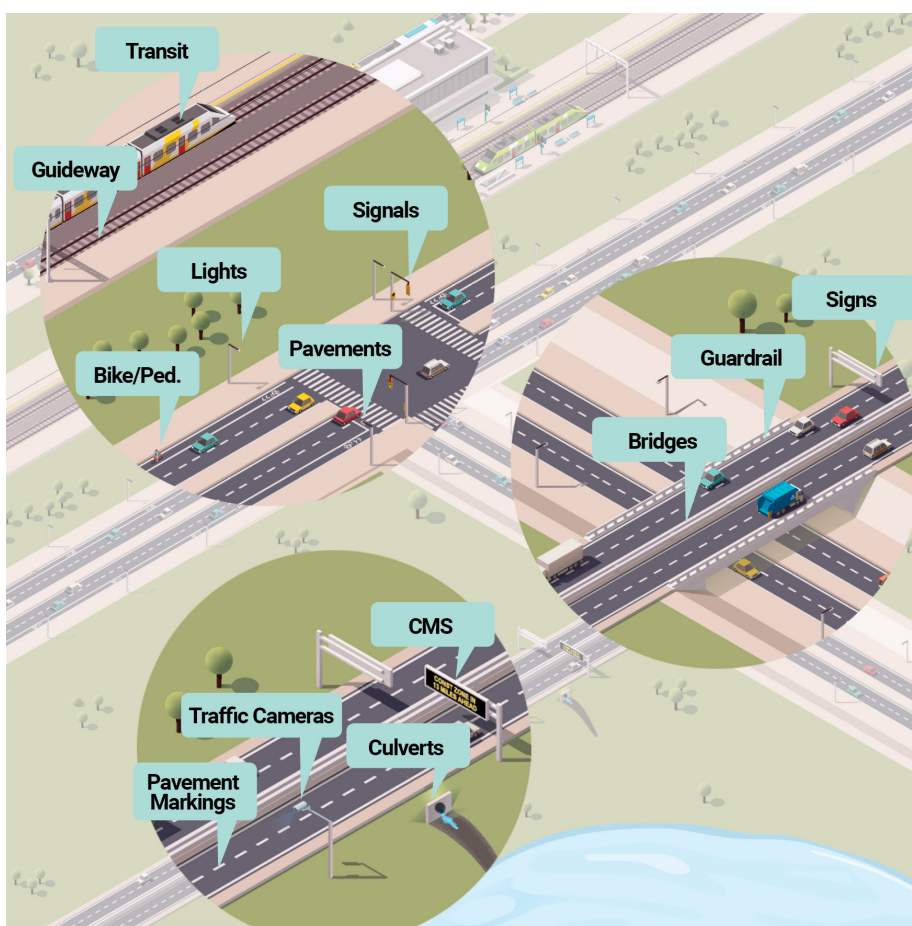


Figure 1.1 Common Highway Assets



Definitions

It is important to establish key terms that are used throughout the Guide. While many of these terms have multiple or nuanced definitions, the definitions listed here are the assumed meanings used in the context of this Guide. Each chapter also lists important terms that expand on this list.

Transportation asset management (TAM) is defined by AASHTO as a strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their life cycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based on quality information and well defined objectives.

FHWA defines TAM similarly, stating, “Asset management is a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair (SOGR) over the lifecycle of the assets at minimum practicable cost.”

In the International Standards Organization (ISO) Standard 55000, asset management is defined as the “coordinated activity of an organization to realize value from assets. Realization of value involves the balancing of costs, risks, opportunities and performance benefits.” In addition, the ISO standard states that “Asset management enables an organization to examine the need for, and performance of, assets and asset systems at different levels. Additionally, it enables the application of analytical approaches towards managing an asset over the different stages of its life cycle (which can start with the conception of the need for the asset, through to its disposal, and includes the managing of any potential post-disposal liabilities).”

Performances measures are quantifiable metrics that are used to track progress toward goals, objectives, and established performance targets.

A **performance target** is a level of performance desired to be achieved within a specific time frame.

State of good repair (SGR) refers to a condition in which existing physical assets, both individually and as a system, are functioning as designed within their useful service life and are kept functional through regular maintenance and replacement programs.

Levels of service are an agency’s stated commitment to deliver asset service at a specified level of quality and reliability. Service levels can be asset performance related or customer/regulatory-related (complaints, meeting regulatory requirements). These levels of service can include, but are not limited to, the historic “level of service” used to grade traffic congestion.

Asset condition refers to an asset’s current state, as specifically defined by its appearance, perceived level of service, and observed physical state, whether or not it impacts its performance.

Risk is the positive or negative effect of uncertainty or variability upon agency objectives. [23 USC 515.6]

Life-cycle planning and management is a process to estimate the cost of managing an asset class or asset subgroup over its whole life with consideration for minimizing cost while preserving or improving asset condition. [23 CFR 515.5]



Whole-life costing is the systematic consideration of all relevant costs and revenues associated with the development, operations, and maintenance of the asset.

Reliability-centered maintenance is a structured, risk-based approach for determining the maintenance requirement for any physical asset, based on its operating context within the agency.

Resource allocation is the process of assigning scarce resources to investments in transportation assets. The assigned resources can be money, staff time, contractor capacity, equipment, or other organizational requirements for assets. The investments can be capital projects, maintenance efforts, or other projects and activities that require the use of an organization's resources through various delivery methods.



TAM Principles

The foundation of a good TAM program is a set of principles that establishes the values of the agency and the standards by which the TAM program will be carried out. TAM principles are the underpinnings of all of the activities that will be taken in an agency's TAM program and connect to its desired end results.

Policy Driven. TAM should capture and respond to policy objectives and provide meaningful information about how changes in the transportation system support these objectives. A TAM policy can set boundaries, clarify intent, and communicate the scope of a TAM program including types of assets that will be managed and what work activities to emphasize. [NCHRP 551]

Performance Based. TAM should have concrete objectives that are translated into system performance measures used for both day-to-day operation and longer-term strategic management. The use of performance data to support the management of assets enables agencies to select and deliver projects that achieve its objectives. Transparent processes allow for accountability to both internal and external stakeholders.

Risk Based. Risk management plays a role in resource allocation, project selection, long-term planning, and other essential parts of the TAM process. As such, an organization's approach to risk management and the outcomes resulting from a risk assessment have important implications for TAM. An agency must establish a risk management approach and integrate risk management in TAM planning and decision making.

Strategically Aligned with Agency Priorities. TAM measures should be aligned with agency priorities and goals to ensure that investments made to extend asset service

life provide the maximum impact to achieve long-term goals. Connecting performance measures to higher level strategic goals also supports an agency's ability to communicate to customers and stakeholders how technical measures relate to system performance.

Transparent. TAM planning and results should be monitored and reported for both impact and effectiveness. Feedback on actual performance should influence agency goals and objectives, as well as future resource allocation and project decisions. Transparency and agency accountability are key in ensuring the long-term support of project partners, customers, and stakeholders.

Information Driven/Evidence Based. Strategic decisions with respect to agency goals and TAM objectives should be evaluated using credible and current data. Decision support tools such as management systems should be applied to help in accessing, analyzing, and tracking data, and must be an integral part of business and decision processes. Data requirements for performance measures should be realistic and feasible. [NCHRP 551]

Option Oriented. By taking a structured and repeatable approach to TAM decision making, an organization improves its own resilience and ensures that it will continue to succeed even as new challenges arise and personnel changes over time.



Continuously Improved. TAM processes should provide managers with sufficient information to understand problems and suggest solutions. The agency should be committed to regular, ongoing processes of monitoring and reporting results in order to identify and implement improvements to system performance or further the effectiveness of TAM. [NCHRP 551]



TAM Elements

Asset management encompasses the full set of business processes related to the management of physical assets. There are several key TAM elements listed below that offer the greatest opportunity to improve an agency's asset management efforts.

Monitoring the state of the assets and developing desired and expected levels of service (LoS). Performance measures are used to align agency investment decisions with organizational objectives, such as asset condition or system reliability, and to monitor progress towards achieving agency goals. In TAM, asset performance is most commonly defined in terms of asset condition or maintenance LoS. LoS provides the link between agency goals and the investments and interventions that should take priority when managing assets.

Maximizing use of available revenues. Agencies are faced with the problem of determining how to divide scarce resources between different asset types, in order to accomplish a variety of different objectives. TAM planning offers processes to help make these resource allocation decisions, such as multi-objective decision analysis (MODA), long-term financial planning, and life-cycle planning.

Monitoring and managing risk. In TAM, uncertainty complicates efforts to make decisions about the future and forces agencies to be nimble so as to effectively respond to unpredictable events and evolving conditions. An organization's approach to risk management and the outcomes resulting from a risk assessment have implications for TAM. It is important to establish processes

to track changes in risks over time and monitor actions taken to manage risks through tools such as a risk register and/or a risk mitigation plan.

Investing in asset maintenance. State DOTs can specify their desired SGR, consistent with their TAM objectives, for the 10-year analysis period of their TAMP. This strategic long-term maintenance strategy helps agencies minimize the life-cycle costs of preserving assets, while also managing asset performance to a defined target to the extent practicable with available resources.

Understanding the potential for asset failure and developing intervention strategies. Being aware of the potential for asset failure and making strategic investment decisions can help agencies prevent failures, reduce costs, and maintain a desired level of service. Over an asset life cycle, a range of interventions are possible: from reactive, routine, and preventative maintenance to large investment associated with renewal, replacement and disposal.

Allocating resources and prioritizing work based on both short- and long-term performance. The resource allocation process should support achieving short- and long-term goals. An agency must establish which scarce resources must be allocated and what the constraints on these resources are. A key part of the process is to translate



goals and objectives into performance measures so the agency can set target values for key measures, establish a target level of service, or both.

Continuous improvement based on feedback. An agency should have regular, ongoing processes of monitoring and reporting results in order to identify and implement improvements to system performance or further the effectiveness of the performance management process. Ongoing monitoring, problem identification, and improvement should be incorporated into the planning process to help adjust and determine future targets and processes.

Aligning the organization. Successful TAM depends on the alignment of a diverse set of internal business units and external partners and stakeholders. Strategic coordination and communication can bring these people and groups together to achieve TAM goals. In addition, the choice of a TAM organizational model should align with and support agency policies and priorities.



Checklist

Basic Requirements Checklist

This checklist describes the basic requirements of a successful TAM program. Agencies can use this checklist to identify priority areas for TAM improvement efforts.

- ☐ **Leadership Support.** For TAM objectives to be understood and observed throughout the organization, it is important to have access to senior leadership and to be able to work with and get attention from leaders when needed.
- ☐ **Agreement on TAM objectives and scope.** An agency's planning, programming, asset owners, project development and delivery, maintenance, and other units must coordinate to make TAM work. It is crucial to have cross-agency agreement on TAM goals and performance measures.
- ☐ **Designation of key asset management roles.** Understanding what roles and responsibilities are most important for the TAM program is key to getting an agency ready and aligned to achieve TAM-related goals. Agencies must fill each TAM-related role with qualified people who possess the right competencies.
- ☐ **Internal and external coordination mechanisms.** In order to deliver mobility to the public, state DOTs must coordinate internally and with other agencies that own and operate transportation facilities. It is up to the agencies to work together either by forming committees, creating partnerships with external organizations, or developing communication strategies to reach all relevant stakeholders.
- ☐ **Current and reliable inventory and performance data.** TAM decision-making must be based on credible and current data. Data requirements for performance measures should be realistic, feasible, and up to date with respect to asset conditions, as well as current technological requirements and advances.
- ☐ **Functioning analytical tools for major assets.** Decision support tools such as management systems should be applied to help in accessing, analyzing, and tracking asset data, and must be an integral part of an agency's business and TAM decision processes.
- ☐ **Work tracking processes (for system updates).** Agencies must have systems and data collection processes that are measured consistently, collected economically, and updated regularly.
- ☐ **Risk monitoring and management processes.** Monitoring risks to TAM requires clear definitions of ownership for the risks, the mitigation strategies, and the risk management processes. Different mechanisms can be used to address risks, such as risk registers or risk mitigation plans.
- ☐ **Performance monitoring and reporting processes.** Monitoring performance of the asset management system and the results of improvement actions can be challenging, as the cost of service delivery, quality of service levels, and risk of service failures can change following implementation. For this reason, it is important that agencies select measures to monitor the effects of improvements that capture all of these aspects.
- ☐ **TAMP development process.** Agencies need to have a process for preparing a TAMP and then monitoring its implementation. Agencies can create a task group to provide oversight through regular updates, meetings, performance tracking, and schedule monitoring.
- ☐ **Continuous improvement process.** It is necessary for an agency to ensure that asset management practices are reviewed on a regular basis to identify opportunities for innovation and advancement.

●●○
Section 1.2

About This Guide

This section orients the reader to the contents of the guide and describes the framework used to organize the document.

This section has three parts:

1. **Scope and Organization.** Describes the organizing framework for the guide and the contents of each chapter.
2. **Intended Audiences.** Describes the different audiences for the guide.
3. **Ways to Use this Guide.** Provides information on the features of the guide.



Scope and Organization

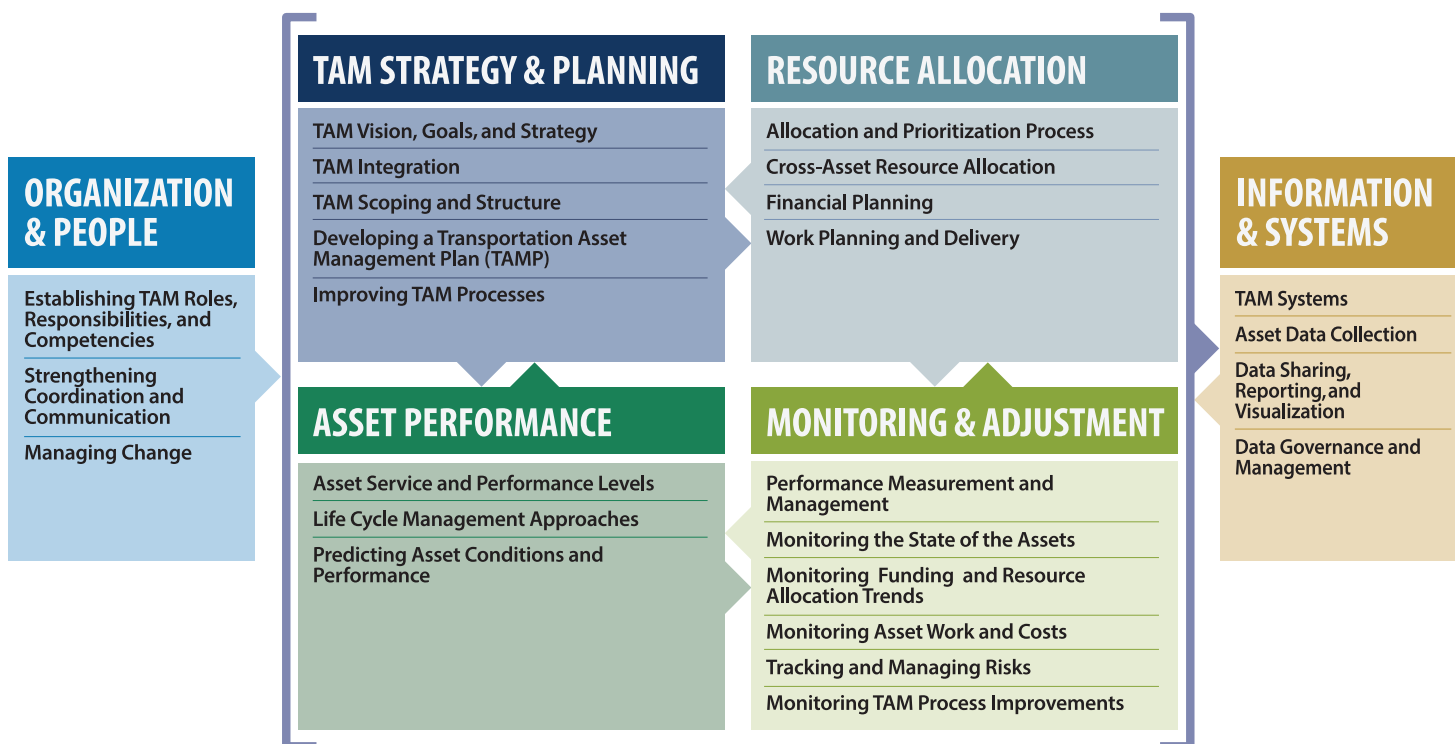
This guide is organized around the basic asset management framework illustrated in Figure 1.2. This framework is tailored for use by U.S. transportation agencies and incorporates critical areas deemed important to the daily application and advancement of TAM practice.

The framework shown in Figure 1.2 groups the components of asset management into six basic areas. The four central areas in the figure capture the business processes involved in asset management.

- **TAM Strategy and Planning.** An organization manages its assets not as an end in and of itself but to achieve broader goals. These goals might include improving mobility, enabling economic growth, and reducing costs to travelers and the environment. It is important to place TAM in the context of an agency's broader goals and objectives, establish the scope of an agency's TAM effort, and determine how TAM integrates with the other activities performed by the agency. A Transportation Asset Management Plan (TAMP) helps establish this context, and preparing such a document is consistent with best practices in TAM. Additionally, U.S. state DOTs and transit agencies are now required to develop TAMPs to comply with Federal requirements.
- **Maximizing the Life-Cycle Performance of Transportation Assets.** This term encompasses the set of processes involved in determining how to manage an asset over its entire life, from construction or acquisition to maintenance and finally asset replacement or disposal. It addresses how to measure the LoS an asset is achieving and is targeted to achieve, how to best maintain an asset, and how to model the condition and performance of an asset in the future.

- **Resource Allocation.** Managing assets requires determining how to best deploy a set of finite resources, including staff time, equipment, and budgets for operating and capital expenses. This area includes the processes involved in making resource allocation decisions, both for a given asset class and across multiple asset classes considering a range of different objectives and constraints. Also, it addresses the development of financial plans summarizing expected sources and uses of asset management funds. TAM financial planning takes a long-term view of resource allocation to support the delivery of strategies that address asset needs at all stages of their service lives.
- **Monitoring and Adjustment.** Ideally an organization's approach to TAM and TAM-related decisions should be dynamic, with adjustments made in response to available data on asset conditions. This area includes processes related to measuring and monitoring asset performance, assessing risk, and making adjustments to investment decisions and business process to respond to changing conditions.

The remaining two areas detail factors that enable an improved asset management approach. The two enablers of an improved asset management approach are:



Source: Adapted from the Institute for Asset Management (IAM). <https://theiam.org>

Figure 1.2 Guide Organizing Framework

- **Information and Systems.** TAM is very data intensive. It is important to have systems for tracking an organization's inventory of assets and collecting needed data on asset conditions. Also, systems are often needed to connect to related data, including financial data and records of maintenance work. However, collecting asset data and implementing asset management systems can be costly and time consuming. It is important to develop an approach to information management that carefully considers what data are needed to support the organization's goals, and how best to collect needed data.
- **Organization and People.** All infrastructure-intensive organizations practice asset management in some manner. However, implementing a robust asset management approach incorporating best industry practices and a philosophy of continuous improvement, requires having a robust

organization and people with the correct mix of skills. Creating such an organization requires defining roles and responsibilities for TAM within an organization. Also, it is important to evaluate needed staff skills and to implement training programs to help existing staff improve their skillsets. Another important organizational factor is developing an approach for managing change within the organization to support a culture of continuous improvement.

The remainder of this guide further details the areas illustrated Figure 1.2, with emphasis on those areas that are specific to TAM.

A basic feature of TAM is that it is interdisciplinary and thus overlaps with a number of other areas, including but not limited to maintenance, project selection and budgeting, performance management, information technology, and risk. To the extent that other resources are available for addressing cer-



tain aspects of TAM, the guide notes these overlaps and recommends other relevant resources.

The core elements illustrated in Figure 1.2 are further detailed in corresponding chapters of the guide:

Chapter 1. Introduction discusses basic TAM information of importance to any reader who is new to the concepts of transportation asset management..

Chapter 2. TAM Strategy and Planning discusses considerations in linking asset management to agency goals and objectives, and defining performance measures and targets for tracking progress.

Chapter 3. Organization and People describes how to build an organizational structure that supports asset management and develop processes for change management and training to build an awareness of asset management throughout the organization.

Chapter 4. Maximizing the Performance of Transportation Assets discusses developing life-cycle plans that define how best to design, construct, operate, maintain, and dispose of assets—and then executing those plans on a day-to-day basis.

Chapter 5. Resource Allocation details the process of making capital and maintenance investment decisions that provide the best long-term performance given available resources, considering trade-offs and competing needs among different assets and investment objectives.

Chapter 6. Monitoring and Adjustment addresses topics including tracking asset health, responding to unplanned events, and managing risks to the asset inventory.

Chapter 7. Information and Systems addresses collecting needed asset data, and implementing management systems to support data collection and decision-making.



Intended Audiences: Who Should Use This Guide?

The guide is an important tool that should be actively used as a reference by the transportation community. The principles and implementation techniques described here are universally applicable to all agencies managing transportation assets. While the target audience is primarily state Departments of Transportation (DOTs), local agencies managing metropolitan, county, or mixed transportation networks will also find it useful and appropriate to their needs.

The guide is structured so that the reader can use a particular chapter, section, or topic as a source of advice; or use the whole in order to drive a systematic agency-wide implementation of asset management.

For newcomers to asset management.

This guide is a great starting point for DOT staff new to the field of asset management. Recent college graduates and new DOT employees hired in asset management roles, as well as DOT staff who have transferred to an asset management role from elsewhere in the agency, will benefit from the overview of asset management provided in this guide.

For practitioners. This guide can help advance asset management practice at an agency. The framework is designed to provide information on all different aspects of asset management, so practitioners can easily access information specific to the challenges they are currently facing. Practitioners can also learn about how peer agencies approach different aspects of asset management through the numerous practice examples throughout the guide.

For executives. This guide is intended to raise awareness among senior executives about the wider role TAM plays within the agency and how it can be implemented to improve organizational performance and achieve better outcomes in terms of cost and service to the public. Agency-wide TAM implementation needs to be led by top management using the principles of effective leadership. TAM is an organizational culture and professional discipline that should not be switched on and off with the regular election cycle; it needs continuity and support even as leadership within the organization changes. Implementation needs to transcend administration.



Ways to Use This Guide

The guide provides an overview of TAM topics and also includes practice examples, how-to guides, checklists, and references.

Basic Overview of TAM

A general overview of TAM is provided below in Section 1.2. This is a great place for people who are new to asset management to learn the basic fundamentals and benefits of TAM before getting into the details in the remaining chapters.

Topical Guidance

Each chapter of guide provides topical guidance for the practitioners looking to advance a particular aspect of TAM within their agency. While there are certainly cross-cutting topics in TAM that are mentioned in more than one chapter, each chapter is meant to be a stand-alone topic that a practitioner will find useful without having to read the entire guide.

Practice Examples

There are numerous practical examples in each chapter of the guide that illustrate how particular aspects of TAM are applied in real world situations. A diverse range of DOTs, MPOs, and international agencies are featured in the practice examples. These illustrate the varying priorities and wide array of challenges facing agencies of all sizes.

Maturity Scale

Each chapter concludes with a summary of the typical level of practice of a generic DOT for three levels of maturity: emerging, strengthening, and advanced. The maturity examples are meant to provide some context for the concepts discussed within the

How-To Guides and Checklists

Each chapter of the guide features how-to guides and checklists.

How-to Guides

How-to guides provide step-by-step guidance on achieving a specific aspect of TAM. The following how-to guides are featured in the guide:

Chapter 2

- Develop an Asset Management Policy (2-10)
- Develop a Risk Register (2-22)
- Prioritize Assets for TAM Advancement (2-33)

Chapter 3

- Recruit Individuals for Asset Management Roles (3-19)
- Establish a TAM Steering Committee (3-23)
- Develop a Communications Plan (3-30)
- Manage Change and Prepare for a System Replacement (3-40)

Chapter 4

- Establish Customer-Based Service Level Targets (4-15)
- Life-Cycle Planning for Pavements (4-35)
- Determine What Data Is Needed to Support Life-Cycle Management (4-43)

Chapter 5

- Implementing a Multi-Objective Decision Analysis Approach (5-25)
- Considerations in Implementing a Multi-Objective Allocation Approach (5-26)

Chapter 6

- Benchmark Performance (6-18)
- Use RACI to Create a Responsibility Assignment (6-50)

TIP Readers of the TAM Guide can reach out to specific agencies for further details on the practices highlighted in the practice examples.



Documents
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chapter, and the degree to which an agency incorporates them into their service delivery.

Emerging. The agency is beginning to improve their asset management practices and is emerging to a new way of conducting service delivery. The agency has initiated early steps to implement practices and has a plan for future improvements.

Strengthening. The agency has established many aspects of a functioning asset management system, achieved several important improvements in how it embeds asset management leading practice into the agency, and continues to strengthen its practices to achieve future goals.

Advanced. The agency is a role model among its peer agencies and has fully implemented asset management practices across the organization. TAM is fully integrated into how the agency does business. The agency is advanced relative to most of its peers.

Tips

Where applicable, helpful tips are included at the bottom of the page in each chapter. These short and practical items help reinforce the concepts discussed in the chapter. They can also indicate key points to remember when applying the guidance.

References

At the end of each individual section of the guide, references are provided for more details on specific topics. Practitioners who want to learn more are encouraged to access these references and take advantage of the various resources that are currently available.

Checklists

Checklists address items that should be place to advance TAM practice in a specific way within an agency. The following Checklists are featured in the guide:

Chapter 1

- Basic Requirements Checklist (1-12)

Chapter 2

- Components of Ingredients in an Implementation Plan (2-37)

Chapter 3

- TAM Roles (3-16)
- Assessing an Organization's Change Readiness (3-39)

Chapter 4

- Considerations to Support the Successful Implementation of a Life-Cycle Approach to Managing Assets (4-46)

Chapter 5

- Preparing a TAM Financial Plan (5-34)
- Work Planning and Delivery (5-41)

Chapter 6

- Characteristics of Strong Performance Measures for Managing the Condition of Ancillary Assets (6-14)
- Monitoring External Risks (6-41)
- Risk Management Process (6-49)

Chapter 7

- Data Items to Standardize for TAM (7-16)
- Asset Data Collection Readiness Checklist (7-27)
- Preparing Data for Sharing, Reporting, and Visualization (7-37)



●●●
Section 1.3

TAM Resources

This section provides information on accessing some of the key references used throughout the guide. Each subsection briefly describes the reference and notes how to access the document or information.

This section has four parts:

1. **Frameworks and Guidance.** Provides a summary of the existing frameworks and guidance documents, primarily those available internationally.
2. **Legislation and Regulations.** Summarizes the Federal legislation related to asset management.
3. **Assessment Tools and Maturity Models.** Summarizes the existing assessment tools and maturity models available.
4. **Communities.** Provides information on communities involved in asset management.



Frameworks and Guidance

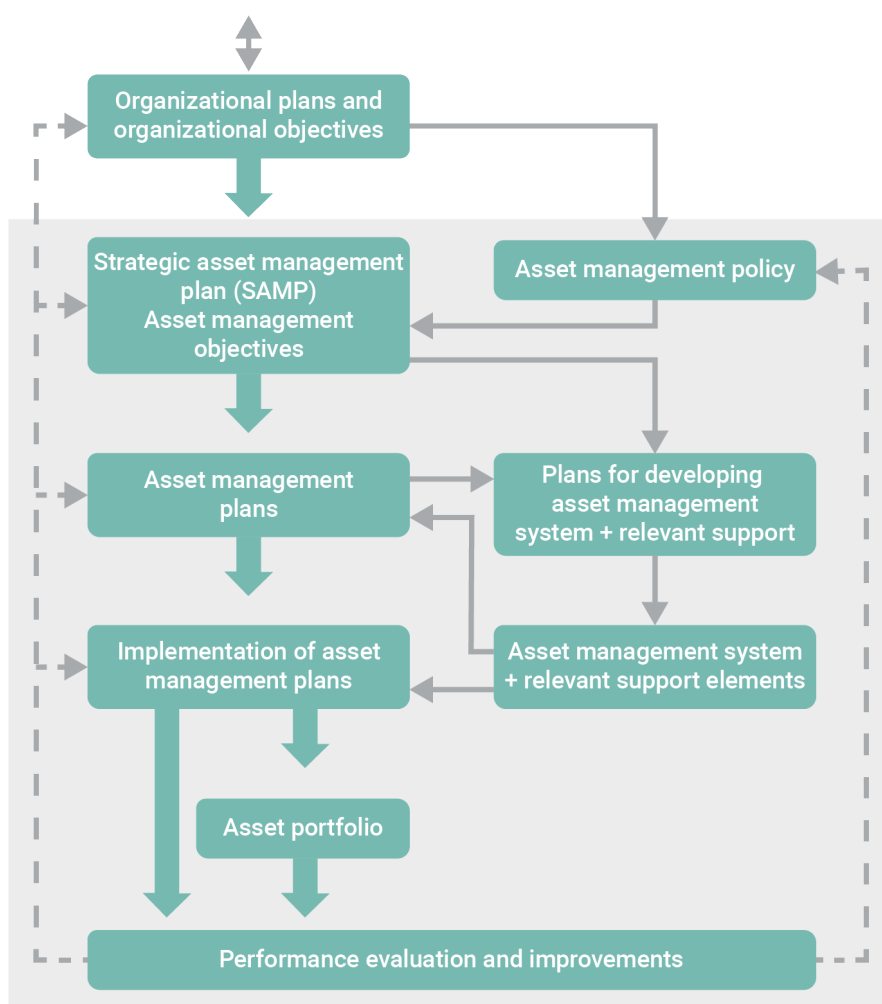
There are numerous existing frameworks, models, and guidance documents related to asset management. This guide is intended to build upon these existing resources and provide updated information where necessary.

International Organization for Standardization (ISO)

ISO has published a set of standards on asset management. Standard 55000 provides an overview of asset management and asset management systems (i.e., management systems for the management of assets). It also provides the context for ISO 55001 and ISO 55002. International cooperation in the preparation of these standards has identified common practices that can be applied to the broadest range of assets, in the broadest range of organizations, across the broadest range of cultures. The adoption of this international standard enables an organization to achieve its objectives through the effective and efficient management of its assets. The application of an asset management system provides assurance that those objectives can be achieved consistently and sustainably over time.

Additional standards related to asset management include ISO 55010, which covers guidance on alignment of asset management, finance and accounting; and ISO 55011, which covers guidance on the development of government asset management policy.

For more information, the standard is available to purchase: <https://www.iso.org/standard/55088.html>.



Source: Adapted from ISO 55000. 2016.

Figure 1.3 Relationship between Key Elements of an Asset Management Program

The gray box designates the boundary of the asset management system.

Publicly Available Standard (PAS) 55

Prior to the development of ISO 55000, the Publicly Available Standard (PAS) 55 was released by the British Standards Institute. This standard contains terms and definitions; information on asset management policy, strategy, and objectives; and discussion on implementing asset management plans, as well as performance assessment and improvement information.

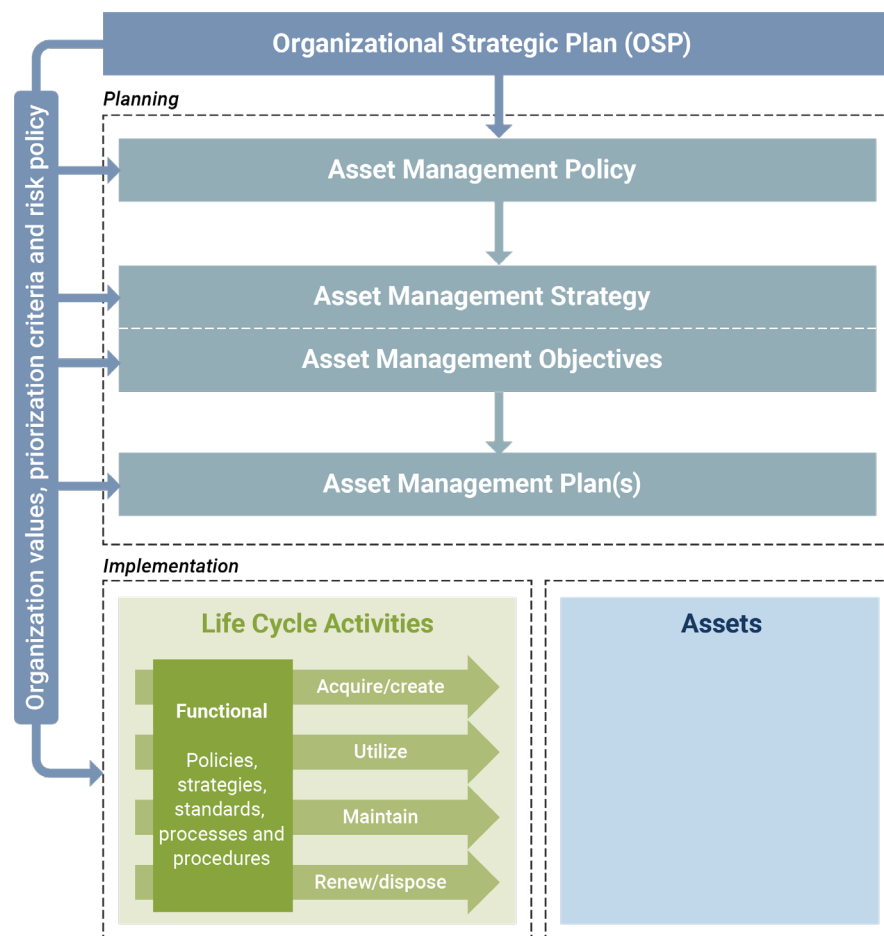
Institute of Asset Management (IAM)

The IAM publication, *Asset Management – An Anatomy* (2015), provides a basic overview of asset management and its benefits. It also provides a discussion of six asset management subject areas: strategy and planning, asset management decision-making, life-cycle delivery, asset information, organization and people, and risk and review. These subject areas are reflected in the framework shown in Figure 1.5.

IAM also has information on developing and maintaining a strategic asset management plan (SAMP). All of their resources can be found on their website: <https://theiam.org/>

Institute of Public Work Engineering Australasia (IPWEA)

IPWEA has produced the *International Infrastructure Management Manual* (IIMM). This guide provides checklists, process, guidance, and case studies on asset management practice from agencies globally. The manual contains guidance for all infrastructure types and is suitable for agencies of all levels of maturity. The manual is written to align with ISO 55000 with a focus on how to implement asset management concepts.



Source: Adapted from PAS 55.

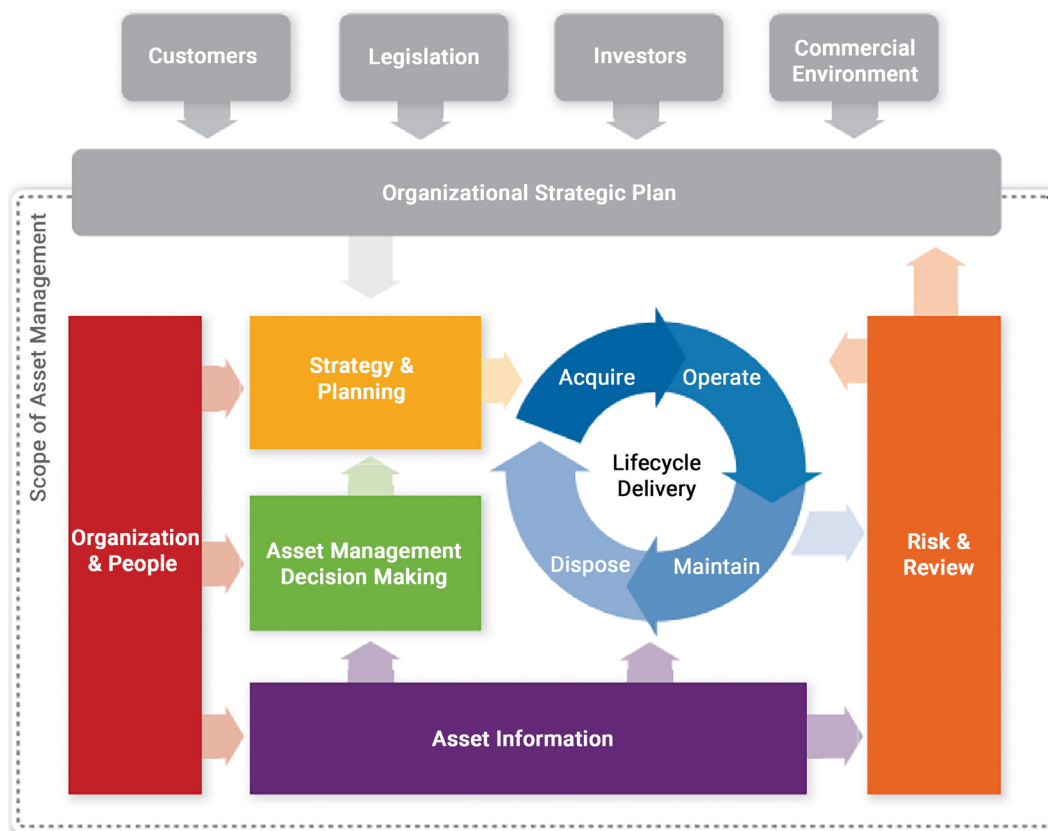
Figure 1.4 Planning and Implementation Elements of an Asset Management System

The IIMM can be purchased from the IPWEA online bookshop, which can be accessed here: <http://www.nams.org.nz/pages/273/international-infrastructure-management-manual-2011-edition.htm>

UK Road Liaison Group

The UK Road Liaison Group developed the publication titled *Well-Managed Highway Infrastructure: A Code of Practice*. This code is designed to support and promote the adoption of an integrated asset management approach to highway infrastructure based on the establishment of levels of service through risk-based assessment. The code is broken into four sections: overarching principles, highways, structures, and lighting. The code also summarizes 36 recommendations put forward to the UK Department for Transport to enhance asset management across UK highway networks.

This document is available online: <https://www.thenbs.com/PublicationIndex/documents/details?Pub=DFT&DocID=319570>



Source: Adapted from *IAM Asset Management—An Anatomy*. 2015.

Figure 1.5 The IAM's Conceptual Asset Management Model



Legislation and Regulations

The Federal government recognizes the importance of asset management practice and requires states to develop transportation asset management plans. Many state governments also have implemented laws related to asset management.

Federal Legislation

The transportation authorization legislation Moving Ahead for Progress in the 21st Century (MAP-21), signed into law in 2012, includes a number of provisions related to asset management and performance management for both highway and transit modes. The requirements established in MAP-21 were continued in the subsequent legislation Fixing America First Act (FAST), signed into law in 2015. For the highway mode MAP-21, defines asset management in the context of transportation and requires that state DOTs develop risk-based transportation asset management plans (TAMPs) for assets on the National Highway System (NHS). The law also includes a number of requirements related to performance management. Regarding transit, MAP-21 requires U.S. transit agencies to develop TAMPs that detail asset conditions and include a prioritized list of state of good repair (SGR) investments.

Following passage of MAP-21 and FAST, the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) developed rules detailing the TAM requirements for highways and transit, respectively. In 2016, FHWA finalized Title 23 Code of Federal Regulations (CFR) Part 515, Asset Management Plans. FHWA's requirements specify that a TAMP should detail asset inventory, current conditions, and predicted future conditions over a ten-year period, using performance measures detailed in

FHWA's performance management regulations. The TAMP should include the following elements:

- Asset management objectives
- Asset management measures and targets
- Inventory and conditions
- Performance gap identification
- Life-cycle planning
- Risk management analysis
- Financial plan
- Investment strategies

In 2016, the FTA finalized asset management requirements that U.S. transit agencies must follow. These requirements are detailed in 49 CFR Parts 625 and 630. The FTA requirements detail that transit agencies must prepare TAMPs covering a four-year period and including their revenue vehicles, infrastructure, facilities, and equipment (including service vehicles). Agencies must use a decision support tool to help analyze SGR investment needs and develop a prioritized list of needs. Larger agencies (with rail systems and/or 100 or more vehicles in peak revenue service) must include additional materials in their TAMP, such as a TAM/SGR policy, TAM implementation strategy, evaluation plan, and identification of resources required to implement the plan.

TIP While regulations do exist, TAM benefits are best achieved when not implemented as a "box-checking" activity.



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Assessment Tools and Maturity Models

Assessing asset management maturity helps establish goals and encourages improvement. This section provides information on existing assessment tools and maturity models agencies can use as resources.

TAM Gap Analysis Tool

This Excel-based gap analysis tool was developed under National Cooperative Highway Research Program (NCHRP) Project 08-90 and builds on the gap analysis tool introduced in the *AASHTO Transportation Asset Management Guide: A Focus on Implementation*. The tool helps agencies identify and prioritize needed enhancements to their asset management programs. The tool is available on the AASHTO TAM Portal: <https://www.tam-portal.com/resource/aashto-transportation-asset-management-gap-analysis-tool-users-guide/>

IAM Maturity Scale and Guidance

The IAM Maturity Scale and Guidance document provides a generic maturity scale for agencies looking to assess their current asset management practice and determine ways to grow and mature. This guidance is available for purchase here: <https://theiam.org/knowledge/asset-management-maturity-scale-and-guidance/>

Data Gap Assessment Tool

To assess data and information maturity, agencies can use *National Cooperative Highway Research Project (NCHRP) Report 814, with Data to Support Transportation Agency Business Needs: A Self-Assessment Guide*. This report provides steps to prepare for the assessment, conduct the assessment, and improve and monitor the agency's data and information maturity over time. The assessment approach presented is flexible and scalable to many different agency needs. The guide helps agencies determine if they have the right data, if their data is good enough, if they are getting full value from their data, and what they need to do to improve.

TPM Assessment Tool

The self-assessment available on FHWA's Transportation Performance Management (TPM) Toolbox (www.tpmtools.org) is available to agencies looking to assess their level of performance management maturity. Three different assessment options are available: a quick, two-minute assessment, a standard assessment, and an assessment by component of the TPM framework presented in *TPM Guidebook*.

TIP Repeated or frequent maturity assessments can be useful for mid-course corrections, however they should be spaced out enough to avoid over-burdening the department or agency.



Documents

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Communities

There are numerous opportunities available for practitioners to interact with people from peer agencies. The following committees and groups provide a way for agencies to share ideas, overcome challenges, and advance asset management practice.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO is a nonprofit, nonpartisan association representing highway and transportation departments in the 50 states, the District of Columbia, and Puerto Rico. It represents all transportation modes including: air, highways, public transportation, active transportation, rail, and water. It aims to foster the development, operation, and maintenance of an integrated national transportation system. AASHTO is an international leader in setting technical standards for all phases of highway system development. <https://www.transportation.org>

AASHTO Committee on Performance-Based Management (CPBM) is dedicated to providing state DOTs the expertise and resources to support performance-based management and to create a results-driven environment to maximize the performance of both transportation systems and organizations. The committee is focused on Organizational Management; Systems Performance; and Federal Policy, Regulations and Programs.

The CPBM's Subcommittee on Asset Management was created to help improve the state-of-the-practice of asset management in state DOTs. The Subcommittee works to help states optimize resources with per-

formance-based goals and measures for operation, preservation, and improvement of their transportation systems. Transportation Research Board (TRB).

TRB provides innovative, research-based solutions to improve transportation. TRB is a program unit of the National Academy of Sciences, Engineering, and Medicine, a nonprofit organization that provides independent, objective, and interdisciplinary solutions. TRB manages transportation research by producing publications and online resources. It convenes experts who help to develop solutions to problems and issues facing transportation professionals, and it provides advice through its policy studies that tackle complex and often controversial issues of national significance. <http://www.trb.org>

TRB Committee on Transportation Asset Management. The Committee seeks to advance the state of the art and state of the practice in asset management. Asset management is a process to strategically manage the transportation system in a cost-effective and efficient manner. Asset management by its nature is a collaborative process, and the Asset Management Committee works with other TRB Committees across all modes, the AASHTO Asset Management Subcommittee, and other partners.



Federal Highway Administration (FHWA)

FHWA is an agency within the U.S. Department of Transportation that supports state and local governments in the design, construction, and maintenance of the Nation's highway system, and various Federal and tribal-owned lands. Through financial and technical assistance to state and local governments, the FHWA is responsible for ensuring that America's roads and highways continue to be among the safest and most technologically sound in the world. <https://www.fhwa.dot.gov>

FHWA TAM Expert Task Group (ETG).

TAM ETG was formed as a forum to discuss changes in the way highway agencies are managing assets. The structure and membership of the TAM ETG were intentionally designed to ensure interaction with key AASHTO and TRB committees. Among its objectives, the TAM ETG aims to identify strategies for advancing asset management practice and influencing change within state DOTs and partnering with transportation agencies.

IAM

The **IAM** is the international professional body for asset management professionals. The IAM develops asset management knowledge and best practice, and generates awareness of the benefits of the asset management discipline for the individual, organizations, and wider society. Established in 1994, the IAM has over 22,000 members in 158 different countries. <https://theiam.org>

IAM US Patron Group. The Patrons of the IAM are a special group of Corporate Members who have committed to a high level of activity and engagement with the Institute, and on that basis, have been invited to become a Patron. The Patrons include leading asset managers who, in exchange for significant support to the Institute, have great influence not only on the development of the IAM itself but also on the development on the discipline.

References

23 USC 515.6. An overview of TAM principles and processes.

Link: <https://www.govinfo.gov/app/details/USCODE-2017-title23/USCODE-2017-title23-chap5-sec515>

Asset Management Overview.

FHWA. An overview of TAM principles and processes.

Link: https://www.fhwa.dot.gov/asset/if08008/amo_02.cfm

IAM Anatomy. IAM. An overview of TAM principles and processes.

Year: 2015

Link: <https://theiam.org>

ISO 55000. ISO. An overview of TAM principles and processes.

Year: 2016

Link: <https://www.iso.org/standard/55088.html>

Performance Measures and Targets for Transportation Asset Management.

NCHRP Report 551, TRB. An overview of TAM principles and processes.

Year: 2006

Link: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_551.pdf

The Geography of Transport

Systems. Rodrigue. An overview of TAM principles and processes.

Year: 2017

Link: <https://transportgeography.org>

Questions & Answers: What is

Asset Management. FHWA. An overview of TAM principles and processes.

Year: 2018

Link: <https://www.fhwa.dot.gov/asset/guidance/faqs.cfm>



Section 2.1

Developing a TAM Strategy



Section 2.2

TAM Integration



Section 2.3

TAM Assessment and
Advancement



Section 2.4

Developing a
Transportation Asset
Management Plan (TAMP)



Chapter 2

TAM Strategy and Planning



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Section 2.1

Developing a TAM Strategy
provides information on creating a TAM policy and aligning it with other strategic plans within the agency.



Section 2.2

TAM Integration
explains the importance of integrating TAM within planning and programming, risk management, and information management.



Section 2.3

TAM Assessment and Advancement
offers guidance on assessing current TAM practice and prioritizing areas for improvements.



Section 2.4

Developing a Transportation Asset Management Plan (TAMP)
introduces the basic elements of a TAMP and describes ways agencies might go beyond the basic requirements.



Chapter 2

TAM Strategy and Planning

Developing TAM strategies is an agency-wide activity undertaken to ensure that the agency delivers on its vision, mission, and defined asset management objectives and targets. A TAM strategy is the big-picture outlook needed to integrate TAM with existing processes and make ongoing improvements once TAM is underway. While practices in TAM strategy development vary across agencies, a strategy will generally establish agency-specific TAM principles, connect to agency strategic goals, and provide a framework for how TAM will be carried out.

Key Terms

Asset Class

A type of asset (e.g., pavement, bridge, sign, signal).

Goals

Broad statements articulating a desired end state that provide strategic direction for an agency. (*TPM Guidebook*)

Information Management

The processes and framework for acquiring, distributing, and storing information at an agency.

Measures

Indicators that track progress toward goals and objectives. Used to establish targets and assess progress toward achieving established targets. (*TPM Guidebook*)

Objectives

Specific, measurable statements that support achievement of a goal. (*TPM Guidebook*)

Performance Management

A process that provides accountability and feedback to ensure that goals are met in an efficient and effective manner.

Planning

The use of agency goals and objectives to drive development of strategies and priorities in the long-range transportation plan and other plans and processes. (*TPM Guidebook*)

TAM Policy

Defines the approach the agency will take to achieve the goals and objectives set forth in the strategic plan.

Principles

From a TAM perspective, fundamental ideas that serve as a foundation for making decisions to better address infrastructure needs.

Programming

The use of strategies and priorities to guide the allocation of resources to projects that are selected to achieve goals, objectives, and targets. (*TPM Guidebook*)

Risk Management

The processes and framework for managing potential risks, including identifying, analyzing, evaluating, and addressing the risks to assets and system performance. (23 CFR 5.15.5)

Strategic Plan

Sets a vision for the future of the agency and defines the goals and objectives to achieve that vision.

TAMP

Transportation Asset Management Plan

Targets

Quantifiable levels of performance that an agency must achieve within a specific time frame. (*TPM Guidebook*)





Section 2.1

Developing a TAM Strategy

TAM strategies and plans should be integrated within the agency's overall vision and strategy documents and other related plans. A stand-alone TAM policy can also be used to establish leadership support, define principles, and communicate the purpose of TAM.

This section has two parts:

1. **Integrating TAM within Agency Strategic Plans and Policies.** It is important to include TAM as a part of agency-wide plans and policies in order to establish the role of TAM within the agency.
2. **Creating a TAM Policy.** This section outlines the key aspects of a TAM policy and how to develop it.



Integrating TAM within Agency Strategic Plans and Policies

Integrating TAM within existing strategic documents is key to ensuring TAM is established and sustained.

TAM is not a stand-alone practice that is only applicable to select areas of a DOT. Ideally, TAM principles and practices should be integrated within an agency's vision, mission, and strategy documents (see Figure 2.1). TAM promotes accountability, preservation, data-driven decision-making, and the optimization of resources; all of these are broader strategic goals often outlined in plans and policies other than a TAMP. Aligning TAM with the agency's strategic documents helps ensure an agency's vision is all encompassing and cohesive.

These documents include:

- Agency-wide strategic plan, business plan, or both (including long-range plans)
- Agency-wide financial plan

- State long-range plan
- Other performance plans (safety, mobility, freight, etc.)

In addition, some agencies may choose to adopt a TAM policy with principles that the agency will follow. A TAM policy can be used to communicate the purpose of TAM and build understanding and support for TAM within the agency. It can also help to sustain a TAM approach through leadership changes. See the next section for further information on creating a TAM policy.

Practice Example Integrating TAM

Michigan DOT

MDOT's 2017 strategic plan has seven strategic areas of focus. A key focus area is system focus, which aims to provide cost-effective, integrated, and sustainable transportation solutions. The first strategy under this focus is to "apply asset management principles to prioritize and implement the most cost-effective transportation investment strategies." This connection between MDOT's strategic plan and their TAM program communicates the importance of asset management in how the agency conducts business. It gives TAM a seat at the agency-wide strategic plan monitoring sessions and allows for the resources needed to carry out TAM activities.

Source: Michigan DOT. 2017. *MDOT Strategic Plan*. https://www.michigan.gov/documents/mdot/MDOT_2017_StrategicPlan_553573_7.pdf

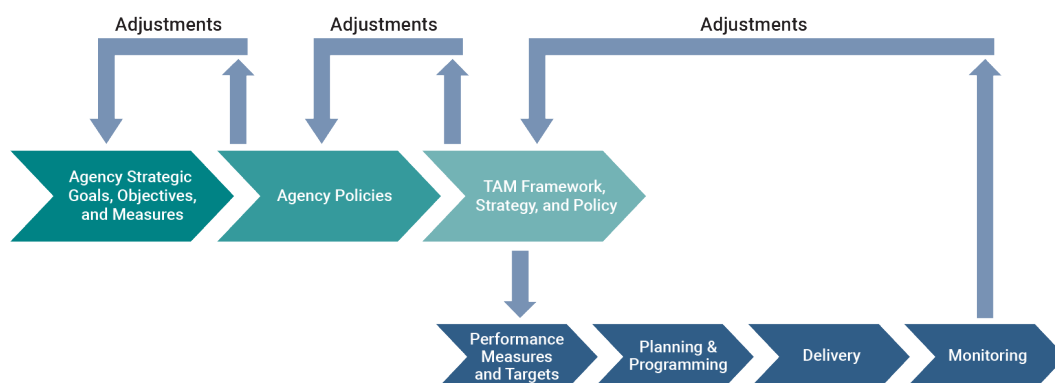


Figure 2.1 Aligning Policies and Plans

TIP Line of Sight' is a concept that describes alignment of an agency's asset management practice to its strategic goals and business objectives.



Creating a TAM Policy

A TAM policy describes the adoption of asset management principles for managing infrastructure. It defines the intent of the TAM program and can include how TAM will be carried out in the agency. Leadership direction on the policy helps achieve buy-in throughout the agency, making it easier to ensure it connects to and aligns with other strategic documents.

A TAM policy can be the first place an agency communicates the strategy of their TAM program. It can be thought of as a contract between the agency and its customers, partners, and stakeholders that defines how TAM fits within the agency's decision-making process.

Some elements of a TAM Policy can be included within a TAMP (TAM objectives, scope of TAM, connection of TAM to other planning initiatives, and TAM roles). However, a separate TAM policy may provide those responsible for TAM within an organization the ability to challenge existing processes and approaches. A concise TAM policy defines the principles that guide the decisions made during TAMP development and implementation.

A TAM policy can outline the types of assets considered for management and identify where in the cycle of DOT work activities to emphasize asset management practices. It can also establish the high-priority initiatives on which the agency will focus their efforts. A TAM policy starts to set boundaries and clarify the intent of asset management.

A TAM policy may include:

- Definitions of services provided to customers and distinctions between service levels
- Approaches for managing assets from a whole-life perspective

- Decision-making standards based on the triple bottom line (economic, environmental, and social)
- Consideration of risk
- Approach for making transparent, data-driven decisions

For further details on developing a TAM policy, see the how-to guide in this chapter.

TAM Goals, Objectives, Strategies

TAM goals and objectives support and communicate the policy and align with the broader agency vision, mission, goals, and strategies. Goals and objectives may cover transportation system performance and desired outcomes, as well as agency decision-making approaches and practices. Some agencies have goals and objectives, while some have only goals and others have only objectives. Regardless of the terminology that is used, it is important that agencies set a vision and establish a direction to move towards. The Oklahoma DOT practice example highlights their TAM objectives.

Agencies should include a clear statement of TAM principles—either within the agency's strategic documents or as a stand-alone policy. They should also seek opportunities to strengthen the integration of TAM within the agency's strategic planning efforts.

Practice Example TAM Objectives

Oklahoma DOT

The Oklahoma DOT identified the following TAM objectives to help guide their asset management program:

- Maintain (improve) the condition of the state's bridges and roadways
- Reduce risk associated with asset performance
- Make better data-driven decisions about assets
- Reduce costs and improve efficiency, including effectively delivering projects that support asset management
- Increase internal and external communications and transparency
- Improve customer service
- Improve safety on the state's transportation system
- Enhance mobility of people and goods



Ingredients for Success in Creating a TAM Policy

The following are some of the key ingredients that make a TAM policy successful.

Leadership Support



Leadership support and direction in the effort to create a TAM policy is important. Effective leadership ensures and maintains a connection across the various types of goals. A typical transportation agency has a lot of moving parts and multiple, sometimes conflicting, priorities. The nature of TAM and its success in meeting TAM goals involves actions that cut across individual business units. Leadership is a critical ingredient in creating positive change and maintaining processes across business units. See Section 3.1 for more information on leadership.

Internal and External Stakeholder Engagement and Support



Involving groups and people who want a voice in the TAM program's success, whether external partners or stakeholders or internal business units, is important for creating policies that will have a positive impact and are sustainable. See Section 3.2 for more on stakeholder engagement.

Consider Implementation



There may be multiple ways to accomplish policy objectives, so the policy should be simple and flexible rather than complex and rigid.

Link to Performance Management



Performance management is an underlying component of good asset management. Policies should consider the ability to define performance measures, collect data, and measure performance. They should also consider the cycle of setting objectives, monitoring performance, and making adjustments. See Section 2.2 for more on TAM performance and monitoring.

Practice Example TAM Policy

Amtrak

Amtrak Engineering's asset management policy identifies guiding principles that the agency intends to use in managing the infrastructure it owns and maintains. Specifically, the policy focuses on developing asset management capability and implementing the TAMP. The policy begins with a purpose statement that defines asset management, and then lays out seven principles (or standards) to guide asset management practice. The principles highlight ownership, transparency, risk management, life-cycle costs, and information systems standards for Amtrak's asset management practice. In addition, the policy also identifies responsibilities and leadership commitment, calling out specific positions in the agency and their role in delivering the asset management plan. The policy is included as a section in their asset management plan and is signed by the President and CEO, EVP Chief Operating Officer, and VP Chief Engineer.

TAM Principles

FHWA Principles of Asset Management

FHWA has defined a number of basic principles for asset management as listed below. All of these ideas work together to help an agency make decisions to better address their infrastructure needs. Asset management should be:

Policy driven. Decisions reflect policy goals and objectives that define desired system condition and service levels.

Performance based. Performance information is used to establish target levels, to allocate funding, and to monitor progress.

Risk based. Risk management is used to identify, analyze, evaluate, and address the risks to assets and system performance.

Option oriented. Comprehensive choices and trade-offs are examined at each level of decision making.

Data driven. Management systems and tools that utilize quality data are used to support decisions.

Transparent. There are clear criteria for making decisions.



Practice Examples

Adopting Asset Management Principles • Seattle DOT

Seattle is one of the fastest growing cities in the U.S. and the demands on the transportation system have grown dramatically. Meanwhile, the system is aging. Seattle DOT (SDOT) needed to find a way to balance infrastructure expansion, preservation, and maintenance by aligning its asset management practices with its service delivery strategies. All of this had to occur within the limits of available resources and ensure that SDOT strategically managed the transportation system for years to come. SDOT's asset management initiative provides a long-term vision of how SDOT intends to accomplish its mission. In 2007, SDOT began implementation of a strategic and systematic process that guides decisions about construction, maintenance, and operation of SDOT infrastructure. SDOT identified and adopted the following three key principles of asset management:

- Build, preserve, and operate transportation infrastructure services more cost effectively with improved asset performance;
- Deliver to customers the best value for public tax dollars spent; and
- Enhance the credibility and accountability of SDOT to the Mayor and City Council

These principles were intended to identify the outcome of a fully implemented asset management program at SDOT. They are supported by a longer list of asset management principles (<https://www.seattle.gov/transportation/about-sdot/asset-management>) and an asset management policy that identify the areas of focus. The Policy highlights the steps SDOT intends to take recognizing that achieving the key principles is a long-term effort achieved through continuous improvement.

Creating an Asset Management Policy • Colorado DOT

In 2015, the Colorado Department of Transportation (CDOT) updated Policy Directive 14, (PD 14.0) "Policy Guiding Statewide Plan Development," to reinforce the importance of TAM in the transportation budget allocation process. It includes the following objectives:

- Infrastructure Condition—Preserve the transportation infrastructure condition to ensure safety and mobility at a least life-cycle cost
- Maintenance—Annually maintain CDOT's roadways and facilities to minimize the need for replacement and rehabilitation

Embedded in this policy are target-setting requirements that the Transportation Commission requested. A performance tracking mechanism is tied to this policy directive. This performance management focus is reinforced annually in a PD 14.0 workshop hosted by the Transportation Commission where the most recent performance results are presented.

2017 Policy Directive 14 Scorecard

Infrastructure Condition

Highways

PD 14.0 Objectives	2017				2016				Dedicated Funding Sources ¹	Notes
	Budget	Target	Results	Target Met ²	Budget	Target	Results	Target Met ²		
Achieve 85% High/Moderate Drivability Life for Interstates based on condition standards and treatments set for traffic volume categories.		80%	88%			80%	94%		Surface Treatment Program RAMP Funding	Although targets were met in 2017, given the current planning horizons, it is anticipated that targets for pavement condition will not be met beginning next year, and will continue to remain below the target through 2027. In 2027 it is anticipated that only 45% of the state highway system will have high or moderate drivability life. \$200 million per year is needed annually beyond FY 2022 to achieve the target by 2027. SDOT will work to improve highway life by increasing pavement maintenance and pavement condition monitoring, and evaluate the effects of pavement preservation measures on life to identify strategies. Additionally, continuing work to align current life metrics with new life metrics of Good/Fair/Poor pavement condition of the NIS System.
Achieve 85% High/Moderate Drivability Life for RHD, excluding Interstates, based on condition standards and treatments set for traffic volume categories.	\$252.1 million	80%	84%		\$235.9 million	80%	88%			
Achieve 85% High/Moderate Drivability Life for the state highway system based on condition standards and treatments set for traffic volume categories.		80%	80%			80%	88%			

Infrastructure Condition

Bridges

PD 14.0 Objectives	2017				2016				Dedicated Funding Sources ¹	Notes
	Budget	Target	Results	Target Met ²	Budget	Target	Results	Target Met ²		
Maintain the percent of RHD total bridge deck area that is not structurally deficient at or above 90%.		90.0%	95.8%			90.0%	95.5%		Colorado Bridge Enterprise On-System Bridge RAMP Funding	A structurally deficient bridge is typically one where corrosion or deterioration has resulted in a portion of the bridge being in poor condition. For example, when water leaking through an expansion joint has caused the end of a steel girder to rust. Currently exceeding target and will continue to exceed target through 2027. \$1.1 million is needed to maintain the current target and meeting the target in 2027. However, the bridge program has 7 metrics geared towards mitigation of risks (defects), and none of these are not achieving their target. For the worst risk mitigation metrics not achieving their target, staff are working to identify additional strategies that can be implemented with no additional funding. Current strategies include identifying bridges that can easily be repaired or retrofitted with the most cost-effective treatment. Score critical bridges are at risk of failure during a storm event of sufficient size. A bridge with a vertical clearance of less than 14'-6" (currently maximum vehicle height) has a high risk of being hit by a tall load on legal load. Changed target last year (2017 Target = 0.04; 2016 Target = 0.48) due the number of bridges with vertical clearance is greater than projected. 18'-4" is the minimum clearance used when designing new bridges over a roadway. A bridge with a vertical clearance less than 18'-4" but greater than or equal to 14'-6" has a medium to high risk of being hit by a tall load. Changed target last year (2017 Target = 18.0%; 2016 Target = 4.8%) due the number of bridges with vertical clearance is greater than projected.
Maintain the percent of state highway total bridge deck area that is not structurally deficient at or above 90%.		90.0%	95.4%			90.0%	95.1%			
Percentage of CDOT-owned bridges over waterways that are score critical.	\$167.4 million	5.0%	6.5%		\$164.1 million	5.0%	6.4%			
Percentage of bridge crossings over Interstates, U.S. routes and Colorado state highways with a vertical clearance less than the statutory maximum vehicle height of 14 feet-6 inches.		1.0%	2.4%			0.4%	1.7%			
Percentage of bridge crossings over Interstates, U.S. routes and Colorado state highways with a vertical clearance less than the minimum design requirement of 16 feet-6 inches.		18.0%	21.8%			4.8%	19.8%			

¹ Additional flexible funding sources with a wide range of eligibility could be used to address multiple objectives. Examples include BPP, STP-W, CMAQ, and TAP.

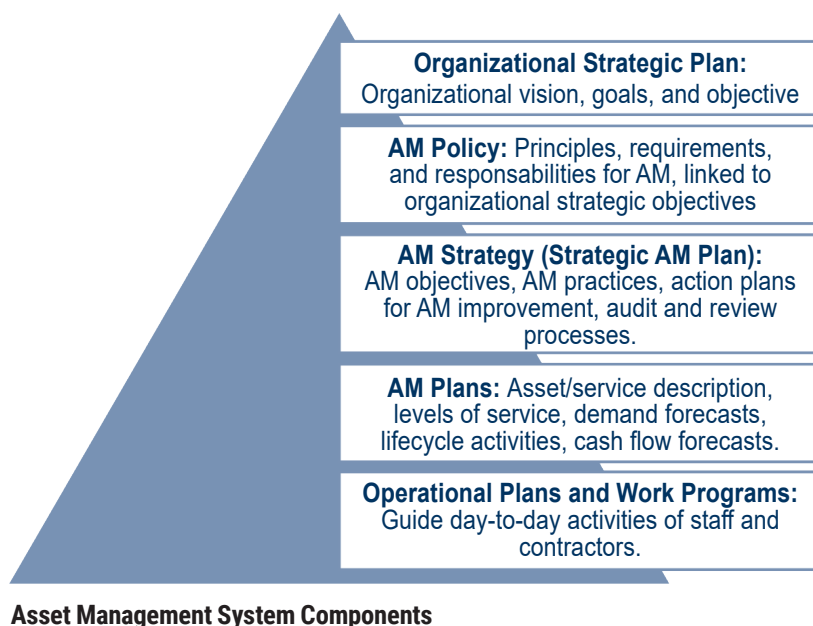
Source: Colorado DOT Scorecard. 2017.

Practice Example Strategic Asset Management System

ISO 55000

ISO 55000 adopts the concept of an asset management system, as the figure at right illustrates, which typically consists of several components:

- An organizational strategic plan sets the overall context.
- An asset management policy establishes the principles on which the agency makes decisions associated with the management of and investment in infrastructure. It seeks to link the organizational goals and objectives to the principles for management of the infrastructure portfolio.
- The asset management strategy, (sometimes termed the strategic asset management Plan or SAMP) establishes how the agency overall will implement asset management and implement the AM policy. It articulates how management processes will function in managing infrastructure and delivering services, as well as how the agency will continuously improve their asset management practices over time.
- Asset management plans developed for individual asset classes (pavements, bridges, ancillary assets) are focused on their individual portfolios. However, they align with the overall agency strategy and are customized to the level of management required.
- Operational plans and work programs guide routine activities and have a line of sight to overall agency goals in this structure.



Within the ISO structure, the TAM framework includes these components but each component may vary in scope. For example, the SAMP may require all asset classes to forecast demand, establish service levels, and have performance indicators, but compliant sub-asset management plans may have different levels of complexity. A bridge asset management plan may be more robust than one for network culverts. The agency can select the scope and structure appropriate for each aspect within the portfolio.

Source: IPWEA. 2015. *International Infrastructure Management Manual (IIMM)*. <https://www.ipwea.org/publications/ipweabookshop/iimm>



How-To

Develop an Asset Management Policy

A TAM policy helps to formalize the asset management practices that an agency uses on a daily basis. It helps ensure that the goals, objectives, and strategies for TAM are unified and pursued consistently across the agency. This how-to guide provides eight steps for developing a TAM policy.

1. Identify who will issue the primary TAM policy and who is responsible for developing the policy

As a first step, it is important to determine the roles and responsibilities for policy development. TAM policies can be developed and issued from many different groups within an agency. Often agency leadership is involved and executive staff work with planning, engineering, or another group to develop the primary policy. The policy can be issued by the agency CEO, a transportation commission, or even the state legislative body. The level of responsibility will also assist in assigning the breadth of accountability for implementation of the policy within the agency.

2. Clarify what the policy intends to achieve

Determine the objectives of the policy. Is the purpose of the policy to:

- Communicate the importance of TAM and the scope of the program?
- Ensure the TAM program is sustained through leadership changes at the agency?
- Bring different parts of the organization together?
- Other objectives?

3. Decide what the policy should include

TAM policies can include:

- Material that communicates the definition of TAM
- TAM principles (see page 2-6)
- Scope of TAM within the agency (e.g., assets included and decisions impacted)
- A vision for where the agency wants to go in the future. That vision could be to maintain all assets in a state of good repair, for example
- How TAM will be managed within the agency or region. Consider who take the lead and who will be involved. See discussion of roles and responsibilities in Section 3.1
- Elements of performance management (e.g., specific performance measures, targets, who determine the targets, who monitors)

In addition, agencies should discuss the time horizon over which the policy will govern.



Developing a TAM Policy

1

Identify who will issue the TAM policy

2

Clarify what the policy intends to achieve

3

Decide what the policy should include

4

Review peers' TAM policies

5

Consult stakeholders

6

Draft the policy and share with stakeholders

7

Produce the final policy and communicate it

8

Review and update the policy



How-To

Develop an Asset Management Policy

4. Review existing TAM policies at peer agencies

Agencies considering developing their first TAM policy do not have to start from scratch. There are existing policies that outline asset management principles from which agencies can draw when developing their own. When reviewing existing policies, agencies can look for elements to adapt to their specific needs and fill in any gaps with other principles they seek to prioritize in their asset management programs. Example TAM policies may be found on the AASHTO TAM Portal.
[http:// www.tam-portal.com](http://www.tam-portal.com).

5. Consult stakeholders on the content of the policy

As an agency develops its TAM policy, it is important to consult internal and external stakeholders on its general contents. Different types of stakeholders may need to be involved using different methods in order to appropriately obtain their input.

6. Draft the policy and share with stakeholders

Once a draft of the policy is available, it is important to circulate it to stakeholders to ensure the policy appropriately reflects all previous discussions and decisions.

7. Produce the final policy and communicate it across the agency

When the policy is finalized, staff should ensure that it is communicated across the agency. The TAM policy should be on the agenda at key meetings throughout the agency to promote awareness. Also, any needed changes to business processes should be implemented to ensure they support the policy.

8. Review and update the policy

Over time the policy should be reviewed and updated if necessary. The need to revisit the process may occur as implementation of the policy matures, or due to changes in roles and responsibilities within an organization, creating a desire to reaffirm a commitment to TAM through this document.



Developing a TAM Policy

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TAM Integration

An integrated view of TAM is critical to its advancement within an agency. Integration ensures TAM is linked to other existing business processes within the agency. Integrated planning considers the life cycle of an asset comprising the “cradle-to-grave” approach. Understanding each phase of the life cycle requires coordination between planning, design, and operations teams.

This section has four parts:

1. **Planning and Programming.** Decisions made during the planning and programming process establish the strategic framework for TAM choices during the delivery and implementation process.
2. **Performance Management.** Within all TAM programs, the use of performance management is critical to align investment decisions with organizational objectives.
3. **Risk Management.** Risk management is integrated with TAM processes at the strategic level. Risk can also be considered at the asset level to understand the impact of asset failure on the wider system.
4. **Information Management.** How agencies manage data and information, and how these are used, are important considerations in TAM.



Planning and Programming

Linking and aligning asset management with planning and programming activities helps strengthen an agency's delivery of projects. Planning and programming processes set strategic direction and resource allocation practices; TAM helps set priorities and encourages data-driven, performance-based decision making.

Planning is the process of setting strategic direction through goals and objectives, then performing analysis to identify trends, strategies, and long-term investment priorities. Planning answers the questions of where to go and how to get there. Programming involves allocating resources in order to determine a program of projects the agency will pursue. Planning and programming are central to the work of any transportation agency. Integrating TAM into the planning and programming process will only strengthen and sustain the practices involved in both areas.

Developing the long-range transportation plan (LRTP) and the statewide transportation improvement plan (STIP) are two planning activities where the integration of TAM is especially relevant.

TAM principles, data, and tools can help shape the LRTP and STIP by:

- Linking agency resource allocation to policy objectives.
- Defining the performance targets to be achieved.
- Identifying strategic investment choices and evaluating and analyzing tradeoffs among them at the appropriate stages.
- Providing the information and analyses to facilitate the appropriate resource allocation decisions that follow good TAM practice.

Integrating TAM approaches with planning and programming goes beyond informing and shaping the activities. Communication and coordination between activities and the people involved in them is important as well. Both planning and TAM require an understanding of the life cycle of an asset. This requires coordination with operations teams to communicate how decisions impact the expected useful life of the asset. Operations teams also need to be aware of the asset management planning horizon, performance measures, and targets. These teams need to ensure the capital plan has been accounted for in the maintenance and operational plans. In addition, since planning is a network-level endeavor, teams managing each of the different asset types need to communicate with one another and coordinate with planning.

The following are some key questions to ask when considering the integration of TAM with planning and programming.

- Is the cost of maintenance and operations taken into account in the decision-making process to select capital projects?
- Are there mechanisms to directly evaluate tradeoffs between capital investment and operations and maintenance implications within the planning process?
- Are the needs and implications associated with connected and autonomous vehicles considered in the asset management plan?

Practice Example Aligning a TAMP to Broader Planning Initiatives

Montana Department of Transportation (MDT)

When developing their 2018 TAMP, MDT aligned their pavement performance targets and goals to those within their planning document, TranPlan 21 (now TranPlanMT).

TranPlanMT defines MDT's policy direction for operating, preserving, and improving Montana's transportation system over a 20-year period. It serves as the guiding document for MDT decisions, especially those related to investing Montana's limited transportation funds.

This type of alignment can help illustrate a link from policy objectives to investment strategies and resource allocation.

Sources:

Montana DOT. 2018. *MDT TAMP*. https://www.tamptemplate.org/tamp/030_montanadt/

Montana DOT. *TranPlanMt*. <https://www.mdt.mt.gov/tranplan/>

TIP TAM practice is most effective when linked to planning and programming activities; this is one way to ensure that TAM principles are implemented into agency decision making.



- Are future risks such as climate change fully integrated into the capital planning process (e.g., rehabilitations, renewal, service level upgrades)? Is scenario planning used to assess the risk effects of system wide external changes?

The FHWA *Asset Management Financial Report Series, Report 4, Integrating Financial Plans into the Planning, Programming, and Budgeting Processes* describes the importance of integrating planning, programming, and budgeting with asset management.

The relative timeframes of various planning and programming activities is shown in Figure 2.2.



Source: FHWA. 2017. <https://www.fhwa.dot.gov/asset/plans/financial/hif16001.pdf>

Figure 2.2 The Relative Timeframes between Plans

Long-range plans, asset management plans, TIPs, and state budgets should be aligned.