Asset Management Guide for Local Agencies

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16. Abstract (Limit: 200 words) Asset management principles and practices are strongly aligned with sustainability concepts; aligning a local government's asset management practices with its sustainability initiatives helps to improve the efficiency and effectiveness of service delivery and investment decisions. This Guidebook has been prepared by the Research Implementation Committee (RIC) of the LRRB and was built on the foundation of the research conducted for the Final Research Synthesis Report. In addition, the RIC researched other public documents. The purpose of this document is to provide guidance in developing an asset inventory and condition assessment, establishing performance measures and goals, identifying and rating risk, determining lifecycle planning and funding strategies, and creating asset management plans and programs using existing and new resources. The research and references cited in this Guidebook demonstrates that the "worst first" approach to asset investment is not sustainable based on the limited financial resources available to local government agencies. A paradigm shift within public and private agencies has begun that is based on sustainable asset investment strategies that utilizes a "mix of fixes." The Guidebook will provide step-by-step guidance for local agencies covering everything from "Getting Started" to "Taking Asset Management to the Next Level" and valuable insight and success outcomes on what others have done, what worked, and what lessons have been learned.			
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Project Resources

This guide and related materials produced by the LRRB are available at *lrrb.org*.

INTRODUCTION

This guide has been prepared by the Research Implementation Committee (RIC) of the Local Road Research Board (LRRB) and was built on the foundation of the research conducted for the Transportation Research Synthesis on Consolidated Asset Management Best Practices. In addition, the RIC researched other public documents. The purpose of this document is to provide guidance in developing an asset inventory and condition assessment, establishing performance measures and goals, identifying and rating risk, determining lifecycle planning and funding strategies, and creating asset management plans and programs using existing and new resources.

The research and references cited in this guide demonstrates that the "worst first" approach to asset investment is not sustainable based on the limited financial resources available to local government agencies. A paradigm shift within public and private agencies has begun that is based on sustainable asset investment strategies that uses a "mix of fixes." The Michigan DOT (MDOT) developed the *Which Road to Fix First* guide that explains this strategy to their stakeholders. MDOT selects road projects that are the "**right fix at the right time on the right road.**" These 10 words define the essence of asset management for road agencies.

Good decisions about infrastructure investment can support and reinforce long-term community visions and goals. This is especially true when local government has a sustainability policy that brings holistic thinking to long-term investment planning. Sustainability becomes an embedded value in a local government strategic plan when it is integrated across all aspects of decision-making and when there is a commitment to evaluate alternatives with a long-term perspective that aims to benefit current and future citizens. Asset management principles and practices are strongly aligned with sustainability concepts; aligning a local government's asset management practices with its sustainability initiatives helps to improve the efficiency and effectiveness of service delivery and investment decisions.

The guide provides step-by-step guidance for local agencies covering everything from getting started to taking asset management to the next level.

The reference materials, examples, templates, and tools provided in the guide document provide valuable insight and success outcomes on what others have done, what worked, and what lessons have been learned.

Definitions

Asset management definitions can be found in almost any document referenced in this guide. The terms and meaning given by the respective authoring source is fairly consistent but the words vary slightly from source to source. Listed below are two examples to illustrate this point.

American Water Works Association (AWWA) Asset Management Definitions

Asset Management Plan: A written representation of the intended approach for the management of infrastructure assets over their lifecycle based on the organization's understanding of service level requirements. A key purpose of Asset Management Plans is to drive longer term thinking and planning and ensure the organization is operating in a financially sustainable manner.

An Asset Management Plan typically includes levels of service, current performance, future demand, risk management, lifecycle management plans (e.g., maintenance plan, rehabilitation and replacement plan), and financial forecasts (AWWA, 2018).

Asset Management Program: A formalized, systematic set of practices to implement the Asset Management Plan within the organization, with a focus on developing asset management capabilities within the organization. The program typically includes the cohesive development, implementation, and integration of people, processes and information systems (AWWA, 2018).

Asset Management Policy: A formal document for organizational leadership (Board of Directors, Executive Management) to signal their commitment and priorities for an Asset Management Program and provides clear direction as to the appropriate focus and the anticipated levels of asset management practice and engagement (AWWA, 2018).

Organizational Strategic Plan: A formal document to communicate the organizational vision, mission, goals, objectives, levels of service, and the strategic actions necessary to achieve those goals. Typically, the business need/s or driver/s for an Asset Management Program would be stated within the organizational strategic plan (AWWA, 2018).

Asset Management Strategy: A long-term optimized approach to management of the assets, derived from, and consistent with, the organizational strategic plan and the asset management policy. the strategy converts the organizational strategic plan and asset management policy into a high-level, long-term asset management action plan and/or Asset Management Program with well-defined and measurable Asset Management Objectives and Key Performance Indicators (AWWA, 2018).

American Public Works Association (APWA) Asset Management Definitions

Asset: Anything that provides value or potential value.

Asset Management: Activities associated with maximizing the value of an asset. In the case of municipal asset management associated with physical infrastructure, these are the activities associated with maximizing the value from physical infrastructure for your stakeholders.

Asset Management Policy: This is the high-level direction of the organization that applies to how assets (physical infrastructure in this case) should be managed.

Asset Management Objectives: The refinement of asset management policy that applies to all assets and clearly provides specific direction.

Asset Management Plan: Specific physical infrastructure (or infrastructure class) set of instructions that further refines the implementation of asset management objectives.

Strategic Asset Management Plan: A broad plan with a specific time horizon associated with implementing asset management policy and objectives.

Asset Management System: The formalized activities (policies, processes, procedures, etc.) associated with maximizing the value of the asset. The difference between this and asset management is the subtle recognition that some activities cannot be formalized but have an impact on the value obtained from the asset.

BACKGROUND

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Asset management is a strategic process that has been developed, used, and evolved over the past 20 years to improve data-driven decisions related to infrastructure investment. The interest by public agency professionals in the principles and implementation of asset management has grown significantly during the past five years. In 2015, the LRRB received a request to develop a Consolidated Asset Management Guide for Minnesota local agencies. At the 2015 APWA Minnesota Fall Conference, LRRB made a presentation that outlined the what, why, benefits, and purpose of asset management for local agencies. Subsequently, LRRB contracted with CTC & Associates to deliver a Transportation Research Synthesis on Consolidated Asset Management Best Practices. In support of LRRB's efforts to develop an asset management guide for cities and counties, CTC & Associates:

- Conducted a literature search on transportation asset management, with a focus on information relevant to local agencies.
- Identified city and county transportation agencies as possible candidates for interview
- Interviewed a national expert from FHWA about existing guidance and best practices applicable to local agencies for initiating, developing, and improving an effective, consolidated asset management system.

The final research synthesis report is entitled, *Consolidated Asset Management for Minnesota Local Agencies*.

In November 2016, LRRB published Report 2016-34B and established an interactive website for the "*System Preservation Guide: A Planning Process for Local Government Management of Transportation Networks*."

The purpose of the *System Preservation Guide* is to offer answers to questions such as:

- How do we evaluate our county's preservation needs?
- How can we describe these needs in a manner that others can readily understand and that describe the impacts of continued under-investment?
- How do we communicate preservation needs to various key stakeholders?
- What strategies can we undertake to address preservation gaps?

The final research synthesis report provides example strategies used by five pilot counties within the state to address their preservation needs. While funding constraints continue to limit investment levels, county and city transportation infrastructure continues to age, and pavement and bridge conditions decline. Thus, asset management is an issue of critical importance to Minnesota counties and cities.

MN2050 conducted a *State of the Infrastructure survey* in 2015 and 2016 to determine to what degree Minnesota cities, counties, and state agencies are using asset management practices. Key findings and recommendations from the report and survey are available at *www.wilder.org/wilder-research/research-library/mn2050-state-infrastructure*. The **MN2050** surveys found that just over half of the agencies responding to the surveys practiced some form of asset management.[1]

In 2018, the American Society of Civil Engineers (ASCE) graded the condition of nine different infrastructure types in Minnesota (i.e., aviation, bridges, dams, drinking water, energy, ports, roads, transit, and wastewater) giving them an overall C grade. The survey noted their importance and aging (i.e., reaching the end of their lifespan). The survey also recommended the broader adoption of asset management systems to better inform professionals and the public about maintenance decisions.

In Indiana and Michigan, all public road authorities are required by state law and/or as a condition of receiving state and federal funding for roads to prepare and maintain an up-to-date Asset Management Plan. In Minnesota, asset management is not required, not funded, and not standardized. As a result, asset management is not consistently used in and by Minnesota public agencies.

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1   Participation by 316 smaller cities (45%) of all small cities that were invited to complete the survey, 129 larger cities (86%), 82 counties (94%) and two state agencies for a total of 529 respondents (56% overall response rate). Also note that responses from 79 jurisdictions from 2015 were included in the 2015/2016 analysis because they did not respond in 2016

WHAT IS ASSET MANAGEMENT?

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Asset management is "*an ongoing process of maintaining, upgrading, and operating physical assets cost-effectively, based on continuous physical inventory and condition assessment*" (Michigan Public Act 4999 of 2022, Section 9(a)(1)(a)). This definition captures several important points about asset management. First, it recognizes that the maintenance of physical assets is an ongoing agency responsibility that must be managed. Second, it points out the importance of making the best choices possible so that resources are used cost-effectively. Lastly, it stresses the importance of having current information on an asset, such as inventory and condition, to help make good decisions.

The goal of asset management is to maximize benefits, reduce risks, and provide satisfactory, financially sustainable service levels to the community. As illustrated in **Figure 3-1**, asset management provides an agency a framework and process for making decisions that helps identify the best possible level of service for each asset that can be provided within the available funding.

Within their *Asset Management Guide for Cities, Towns and Counties*, the Indiana LTAP has identified the following key asset management concepts:

- **Driven by Policy:** An agency's infrastructure budget is spent on items that help achieve the agency's goals and objectives. If you do not know what you are trying to achieve, it makes it difficult to decide what priorities to fund.

- **Based on Performance:** The agency's goals and objectives drive daily decisions about where to spend maintenance and rehabilitation money.

Figure 3-1 Balancing agency goals through asset management. Source: Indiana Local Technical Assistance Program Asset Management Guide (June 2017)

- **Founded on Lifecycle Needs:** Different treatment choices are considered over the life of an asset to keep the annual cost of maintaining the system as low as possible.

- **Supported by Data:** Agencies use reliable information about asset inventory and conditions to make decisions about what projects should be funded.

- **Defensible:** Since every need cannot be addressed, it is important to have a reliable process for selecting projects that can be explained and supports the agency goals.

There are many perspectives of asset management and each of the state, national, and international best practices cited in this guide identifies its own specific definition for asset management.

While these definitions are each unique in the words they use, they share some clear and important messages:

- Asset management is an ongoing, iterative process or approach, not a one-time project.

- Asset management is holistic and integrated.

- Asset management is about creating value and sustainable service delivery.

What is the difference between asset management and managing assets?

Assets are essentially anything that provides value. Managing assets (the things we do to assets) can be done with or without a structured organizational strategy and context. An organization gains more value from managing assets within the context of organizational purpose and strategy that steers this activity and becomes asset management. An agency's coordinated activities to maximize the value of its assets is the Asset Management Program.

WHY IS ASSET MANAGEMENT BENEFICIAL FOR MY AGENCY?

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City and county governments provide a diverse range of services that are essential to a community's quality of life. The services, in part, depend on physical infrastructure assets. These local government assets are the foundation that allows a community to thrive socially, economically, culturally, and environmentally. The management of existing assets, planning for future assets and their connection, and relationship to other essential governmental services has become a high priority for local governmental agencies and reflects the evolution of asset management in local agency strategic planning.

Local governments have been making decisions about infrastructure investments forever. Agencies have learned how to care for those assets and have been managing those assets since they were constructed. Regardless of the size of the agency or the value of its assets, public assets require money to maintain and replace, and decision-makers and elected officials need and benefit from tools that can help prioritize, plan, and implement cost-effective maintenance and replacement strategies.

Creating an Asset Management Plan allows an agency to properly plan investments and attain optimal asset lifecycles. A proper plan that includes maintenance strategies chosen and applied at the right time results in an overall improved system condition and a slower rate of asset deterioration, as illustrated in **Figure 4-1**. Using asset management, an annual plan and corresponding budget can be established that maximizes investments and systematically maintains each asset in a strategic way. With planning, a specified amount of money can be programmed each year for systematic improvements in a way that is data-driven and documented.

The benefits of applying asset management principles in your agency include:

- Increase value and return for money spent.
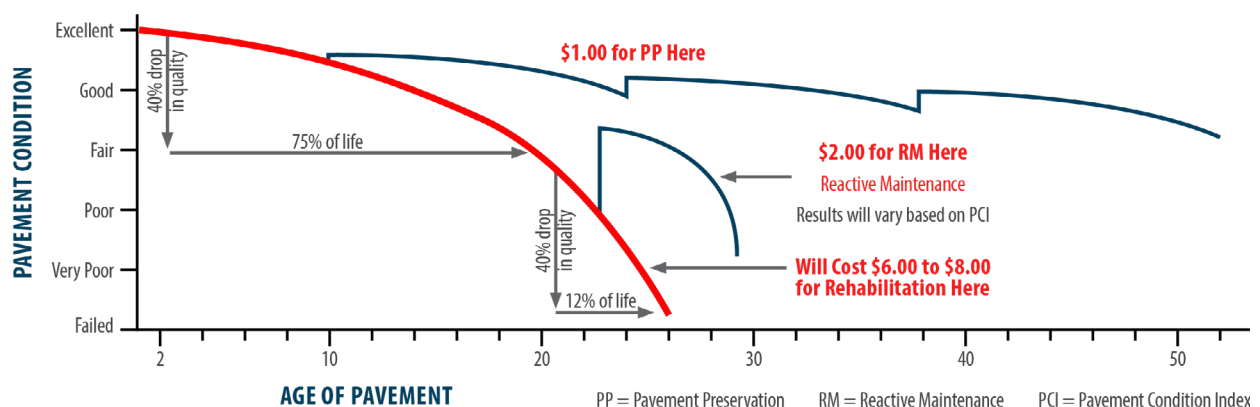- Improve overall conditions by conducting proactive repairs and maintenance.

Figure 4-1 Pavement deterioration curves reflecting varied investment strategies. Source: Chippewa County Highway System Report and Presentation by SRF Consulting (June 2017)

- Make more informed, strategic, and defensible decisions through use of data.

- Facilitate communication of funding needs with agency staff, the public, and elected officials.

- Minimized lifecycle costs and thereby optimized the assets performance over its life.

- Improved customer satisfaction.

- Provided level of service matching public expectation.

- An unbiased methodology to balance trade-offs between competing objectives.

- Addressing the risk to the sustainability of the asset.

- Aligned goals, resources, and organization around things that matter most.

- Transparency and accountability for decisions and expenditures.

The Canadian Province of British Columbia has developed an Asset Management Framework (**Figure 4-2)** that focuses on desired outcomes rather than prescribed methodologies. The framework helps agencies establish a high-level, systematic approach that supports service delivery, asset, and financial sustainability through an asset management process.

Figure 4-2 An asset management framework for sustainable service delivery. Source: Asset Management for Sustainable Service Delivery: A British Columbia Framework

ASSET MANAGEMENT PLANS AND PROGRAMS

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According to the *Institute of Asset Management (IAM)*, an Asset Management Plan is "*documented information that specifies the activities, resources, and timescales required for an individual asset, or a grouping of assets, to achieve the organization's management objectives.*"

Developing an Asset Management Plan begins a more formal process that allows an agency to take a strategic view of the system needs, which is intended to help ensure that the agency is investing in projects that promote the agency's goals and make sense from a long-term perspective.

Many agencies have in place some form of an Asset Management Plan. Some are simple, others are more complex. Either can be effective, and there is not one size that fits all. A good Asset Management Plan is one that best fits your organization.

Asset management is not a software, or just a plan – it is a process for making decisions about how infrastructure is used and maintained. Asset management has a broad focus as it can encompass many organizational levels and apply to all functions and agency departments. The terms and concepts are explained in *ISO 55000 Asset Management*, which shows how the application of broader asset management approaches can help an agency extract the most value for their stakeholders.

An Asset Management Plan helps an agency manage its assets, but it is only one component of a comprehensive Asset Management Program. An Asset Management Program includes formalized activities (that is, policies, objectives, strategies, processes, procedures, and governance) asso-

ciated with maximizing the value of the asset. The American Public Works Association (APWA) in a document titled '*Guide to Successful Asset Management System Development*' (April 2018) indicates that there are four key fundamental components, illustrated in **Figure 5-1**, of an Asset Management Program. These fundamental components are based on the *International Organization for Standard's Asset Management – Management Systems – Requirements (ISO 55001)* document. The standards lead you to strategize, plan, create documents, and manage information. This document can be purchased at *https://webstore.ansi.org/SDO/ISO*.

Asset Management Policy	Asset Management Objectives
Strategic Asset Management Plan	Asset Management Plan(s)

Figure 5-1 Fundamental Concepts of an Asset Management Program. Source: APWA Guide to Asset Management System Development (April 2018)

An Asset Management Program consists of four fundamental components:

Asset Management Policy

This is the high-level direction of the organization or agency that applies to how all assets should be managed. The asset management policy is designed to bridge the gap between various agency departments and employees. An effective asset management policy begins with strong principles which set the framework for the development of the remaining three system components.

Asset Management Objectives

The refinement of asset management policy that applies to all assets and clearly provides specific direction. Objectives should be specific enough to minimize confusion on expectations. Objectives should be tied to existing organizational objectives in an agency's strategic plans or master plans. Objectives should be **SMART: S**pecific, **M**easurable, **A**chievable, **R**ealistic, and **T**ime-bound.

Strategic Asset Management Plan (SAMP)

The Institute of Asset Management defines a SAMP as providing "*documented information that specifies how organizational objectives are to be converted into asset management objectives, the approach for developing Asset Management Plans, and the role of the Asset Management Program in supporting achievements of the asset management objectives.*" The SAMP is a planning tool to clarify intentions, priorities, and practices to be adopted. It takes a long-term view and considers the combination of organizational needs, stakeholder expectations, and the realities of existing assets and asset management capabilities. It is a broad plan with a specific time horizon associated with implementing asset management policy and objectives.

Items to include in the SAMP include:

- Identification of stakeholder's needs and expectations
- Identification of the areas of interaction, collaboration, and association with other agency departments and employees
- Refinement of asset management objectives to clarify and minimize wasted effort
- Identification of employee training needs and certification requirements
- Identification of communication needs, opportunities, and reporting elements and time periods

Asset Management Plan (AMP)

The final component of an asset management program is the Asset Management Plan(s). Specific physical infrastructure set of instructions that further refines the implementation of asset management objectives. The details of an AMP need to clarify and identify, but are not limited to:

- Roles and responsibilities
- Identification of resources required to complete and maintain the AMP
- Establishment of inventories and timelines to collect data
- Establishment of condition ratings
- Establishment of performance levels of service
- Development of lifecycles
- Identification of risks and opportunities associated with managing the asset
- Prioritization of activities

The Asset Management Policy should drive the SAMP and include asset management objectives. The SAMP should drive the AMP.

ORGANIZATIONAL ALIGNMENT

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Asset management shifts the agency perspective from individual projects to entire asset networks when selecting treatments and allocating resources. For example, it might be better for the overall condition of the entire roadway system to mill and overlay several miles of several roads rather than reconstruct one entire roadway. This shift in perspectives from "worst first" to a "mix of fixes" is often one of the most difficult aspects of the implementation process and requires a cultural change in thinking and planning. It also shows why asset management is more than just keeping a database or spreadsheet inventory: implementing an Asset Management Plan leads to changes in the overall agency strategy and daily work activities, which requires agency training and buy-in from staff and management.

An agency's culture and attitudes about maintenance are important; the most successful asset management programs are implemented within agencies that support the strategy through the entire organization and empower staff to work together for successful implementation. A successful plan fosters an important cultural concept; a direct link between maintenance activities and assets. Culture does not develop on its own; changing attitudes can be difficult and has substantial implications for the program success.

A key finding of the MN2050 Survey is that some agencies do not have an Asset Management Program because of insufficient staffing. For asset management to work, two key commitments are necessary: there needs to be top level support within the agency for asset management and someone must be empowered with the respon-

sibility for leading the effort (an internal champion. The champion manages the data collection, updates inventory, maintains any software tools, and facilitates communication about the program throughout the agency. Identifying a lead staff person or champion is essential as is having dedicated and committed people willing to collect and manage the data, analyze it, and develop useful reports.

Organizational change efforts that fail usually do so in the implementation phase (*Beer and Nohria, Harvard Business Review, May 2000*). In the case of asset management, the failure to implement usually occurs not at the senior management level, but at the lower end of the organization. Achieving an organizational culture that maximizes asset management performance requires a shift in thinking, because it requires activities that are proactive versus reactive (such as replacing culverts based on condition and performance targets rather than waiting for them to fail). This impacts the operations and program planning overall.

The key to successful implementation appears to be the quality of workplace relationships and ability to receive feedback. A supportive culture provides an environment that supports, rewards, and recognizes employees working to maximize performance and achieve agency goals (*Brunetto, Xerri and Nelson, Southern Cross University, 2014*). It empowers staff throughout the agency to work together for implementation. Buy-in and support from elected officials is important and easier to get after data is available that shows the plan is working.

GETTING STARTED

An agency can begin a basic asset management process with the tools that they already own, including Microsoft Excel spreadsheets, databases, or geographic information systems (GIS). Asset management is not a software purchase. While there are many sophisticated computer programs that can assist in an organization's asset management journey, start with the people. Local agencies are already familiar with asset management, most are already doing pavement or bridge management, and many have a bridge and road-mile inventory.

The research offers differing opinions on the best approach to getting started and keep moving forward. This guide provides examples of processes to formalize and advance the practice of asset management. Some experts suggest developing a cross-functional agency asset management team that consists of decision-makers such as administrators, finance directors, engineers, planners, and operations staff to develop the agency's Asset Management Program that includes policies, objectives and strategies first before embarking on the development of specific Asset Management Plan(s).

The reasoning behind this approach is that the usefulness of the Asset Management Plan (the working document) may likely be based on the team's acceptance and perceived benefits, recommendations, and outcomes. The other point of view is to develop a basic Asset Management Plan or strategy first; then take it to the agency administrators, finance directors, and elected officials and demonstrate to them the benefits, recommendations, and outcomes the organization can realize from asset management. The approach is often based on the size of the agency. Smaller agencies can start with a basic plan for a few assets and build a program over time. This allows for incremental budgeting of resources but will take several years to create a robust asset management program. Regardless of the approach chosen, this document will provide guidance on developing all four key fundamental components of an Asset Management Program: management policy, objectives, strategies, and the asset management plan.

The research is consistent on several things that should be done before starting the formal development of an Asset Management Program or one of its four components.

- **Find a champion** within the agency with the interest and passion to learn and coordinate the required effort of developing an Asset Management Program. For smaller agencies this champion may be the City or County Engineer, Maintenance Superintendent or GIS Coordinator. As the program evolves the role of Asset Manager will likely become a full time job.

- **Ask these fundamental questions:**
  - What do I want to accomplish?
  - Why is it important?
  - How will I use the information?
  - Where do I start?"
  - When do I need to start?

- **Set some goals and objectives.**

    Example: The city/county will clearly define their Asset Management Plan goals and objectives that balance community expectations with risk, affordability, and available financial and human resources and do the following:

    – Manage assets and available funding appropriately in order to efficiently and effectively deliver the refined level of service set forth each fiscal year based on available funding.

    – Monitor and review every two years the Asset Management Plan goals and objectives to ensure they are met or support community and council/board expectations and other strategic objectives.

- **Start small and keep it simple as you begin.**

    Example: Instead of tackling all the assets of the entire city or county, start with a simple asset class that has a limited number of features, attributes, and performance goals. Decide what information you have, what information you need to collect, and how you want to organize the data.

- **Identify quick wins – demonstrate value to your team.**

    Example: Work with staff who are receptive to asset management; help someone that is struggling with managing an asset type; and evaluate the maturity of an asset type that has existing data.

The Federation of Canadian Municipalities (FCM) has a detailed, yet visual, tool to help local governments measure and report progress on creating an Asset Management Program. In a document titled *Asset Management Readiness Scale,* the FCM recommends the utilization of five competency building blocks, as shown in **Figure 7-1**, for sustainable service delivery. The building blocks are:

- Policy and governance
- People and leadership
- Data and information
- Planning and decision-making
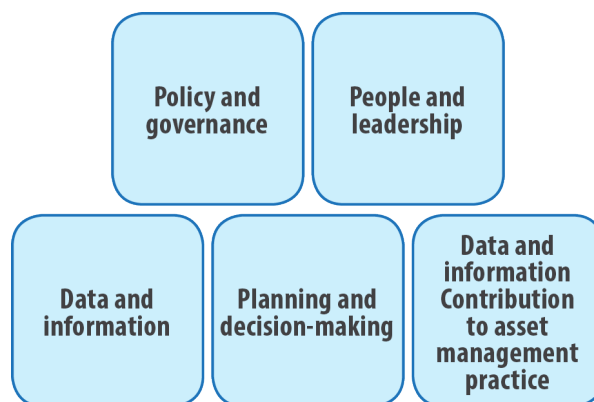- Contribution to asset management practice

Figure 7-1 Five competencies for sustainable service delivery. Source: Federation of Canadian Municipalities: The Building Blocks of Asset Management

This document also includes information to help local agencies who are just getting started and not sure how to get to Level 1 on the Asset Management Readiness Scale.

The document provides a few tips for getting started:

- Understand the terminology and get others in your agency on board so that everyone is speaking the same language.

- Start with the data that you already have or identify things that your agency is already doing that may not be called asset management but could be part of your asset management process, such as a "vehicle window survey" pavement rating approach you have used for years.

- Seek informational resources, such as those provided in this guide, and reach out to these agencies and organizations to get answers to your questions.

- Ask questions and seek guidance from your peers.

For local agencies further along on the road to building an Asset Management Program or Plan, there is also information in this document regarding *How to Develop an Asset Management Policy, Strategy and Governance Framework*.

Several other excellent resources are readily available that provide direction for how to develop an Asset Management Plan:

- The *Indiana Local Technical Assistance Program (LTAP) publication 'Asset Management Guide*' dated June 2017 introduces readers to asset management and outlines the five steps involved in developing an effective Asset Management Plan.

- *Asset Management Getting Started Guide* published by Saskatchewan Province Transportation Department. This guide also has a helpful tool within an accompanying *video*.

- *Getting Started Toolkit User Guide* published by the Alberta, Canada Municipal Affairs Office provides a complete strategy for an agency to begin asset management with the information they already have available. This guide includes description of processes and templates in the form of an editable excel workbook.

- *Sustainable Infrastructure Management Program Learning Environment (SIMPLE) http://simple.werf.org/.* This website has an intuitive and user-friendly set of on-line process and practice guidelines, templates, and decision support tools that will simplify the development of Asset Management Plans and provide effective implementation guidelines for agencies to assess and drive meaningful improvements in asset management.

These tools have been designed to help jump-start agencies in the early stages of the asset management process or to support others with continuous improvement of their Asset Management Programs and/or plans. The purpose of these reference resources is to is to provide a low-barrier path to asset management practices and thinking.

The Asset Management Plan Development Process

The fundamental themes of asset management are outlined in this section and illustrated in **Figure 7-2**. The sections that follow describe each of the respective theme's elements in greater detail.

Figure 7-2 The fundamental Themes of an Asset Management Plan. Source: Simple.werf.org

What is the current state of my assets?

Build Your Asset Inventory: Determine what assets will be inventoried and gather data about asset type, quantity, age, and location. This involves creating a specific asset inventory not only of the assets themselves, but each characteristic that will be managed with the program along with the level of detail and frequency of assessment. The asset information is typically summarized by asset classes and can be presented in a table or graph format. This should summarize each asset class, type, function, and other appropriate descriptors. Age distribution and percent of assets by type are typically used to give a picture of the current system.

Assess the Current Conditions: The condition of each asset must be measured or otherwise quantified. Whenever possible, seek and use an existing data standard to determine asset condition and avoid the cost of creating your own standard. Some examples are good/fair/poor, numeric such as 0-100, pass/fail, compliance with an industry standard (ADA), and functional or non-functional (technology). The level of effort to complete this step will vary based on financial and staffing constraints as someone must perform the condition surveys or judge the existing condition. Create realistic expectations for completing this step that consider time and resources available. Conducting the condition survey accomplishes several things, including creating a baseline for measuring improvements and the ongoing measurement of program trends. The inventory should also report the inspection methodology used and the date range when the condition survey was conducted. It is important to carefully create inventory and condition rating protocols to avoid repetition and inefficiencies.

For more information, see Chapter 9: Data Management.

Determine Remaining Life and Value: Remaining life is the period remaining until the performance of the asset deteriorates to the point of insufficient service. The residual value, sometimes called the salvage value, is the estimated value of a fixed asset at the end of its useful life. It is assumed that the asset has reached the end of its useful life and is in the condition the asset was expected to be replaced. As a general rule, the longer the useful life of an asset, the lower its residual value.

Example: simple determination of % remaining life. Asset constructed in 1989 with a useful life of 50 years :

Determine % remaining life

% remaining life = 1.0 – (% physical life consumed)

40% remaining life = 1.0 – (30 years (in service) / 50 years useful life)

The **remaining value formula** is derived by multiplying the percentage of asset life remaining by the original value of the asset, as in:

Remaining value formula = Original value of asset * percentage of value remaining

Determine Replacement Cost & Date: Including the current estimated asset value and replacement value helps illustrate the significance of an asset or asset class and the importance of managing the remaining life of the asset effectively.

What is the required level of performance?

Performance Target Level of Service: After the condition of each asset is known, the agency can create performance goals, standards, and measures that are often described as performance target level of service such as those shown in **Figure 7-3**.

	CUSTOMER LEVEL OF CONCERN	TECHNICAL LEVEL OF SERVICE	PERFORMANCE MEASURE
Tangibles	• Extent and size of potholes • Clarity of signage • Night-time visibility • Ride comfort at 55 mph	• Maximum size and time to repair • MUTCD standards • Minimum illumination levels on roads—by hierarchy • Roughness	• Number of complaints about potholes • Road users and pedestrians satisfied with signage (%) • Residents satisfied with street lighting (%) • Smooth Travel Exposure
Reliability	• Levels of congestion • Number of signal breakdowns	• Level of service A to F • Number of signal breakdowns and time to repair	• Average duration of rush hour trip from A to B • Outages/year. Maximum and average duration
Responsiveness	• Response time to breakdown or incident	• Response time to breakdown or incident	• Maximum and average times

Figure 7-3 Examples of Level of Service and Performance Measures. Source: AASHTO Transportation Asset Management Guide: A Focus on Implementation, June 2013

According to the AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013), the "*level of service can be considered to be a set of standards, and like any standards, their achievement should be measured and tracked. As achievement of a standard is often called performance, it is relevant to distinguish between the condition and performance of an asset:*

- *An asset's performance is directly related to its ability to provide the required level of service.*

- *Its condition is an indication of its physical state, which may or may not affect its performance.*

An asset can fail through either inability to perform adequately or inadequate condition. Performance of an asset can usually be measured in terms of availability, reliability, capacity, and delivery of other agreed levels of service, whereas condition is measured by factors such as cracking, potholes, loss of friction, corrosion, delamination, and roughness."

In preparing an asset management plan the agency sets performance target levels of service for each asset. For example, a pavement rating system such as Pavement Surface Evaluation Rating (PASER) used by Indiana DOT can be used to set a performance target level of service for a road network and the asset management plan can show historical trends of how the conditions are changing over time. This Guidebook provides the following reference links on how to set strategies, goals, and targets using a variety of tools and benchmarks.

- Transportation Research Board; Guide to Level of Service (LOS) Target Setting for Highway Assets
  - http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_396_contractorsguide.pdf
- City of Alberta Canada; Getting Started / Tookit User Guide; Chapter 2
  - http://www.municipalaffairs.alberta.ca/documents/ms/2015-11-18_Toolkit_-_FINAL.PDF

- National State Auditors Association; Best Practices in Performance Measurement
  - https://www.doh.wa.gov/Portals/1/Documents/1000/PMC-Best_Practices_in_Performance_Measurement_Part_1.pdf
- Chapter 3 of MnDOT's Transportation Asset Management Plan (2019)
  - http://www.dot.state.mn.us/assetmanagement/tamp.html

What assets are critical to sustain performance?

Assign a Risk Rating: ISO 31000 defines risk as "*the effects of uncertainty on objectives.*" Risk can reduce the effectiveness of an agency, and creating a risk management program can reduce threats to the public. Risk management complements asset and performance management. It also helps an agency develop mitigation strategies and achieve their strategic objectives. Risk management may take place on two fronts: 1) the assessment and identification of the potential risks and 2) the management and control of the potential risk. Each area, when not done well, is a contributor to ineffective asset management.

Some examples of agency risks are:
- Economic
- Fraud or malfeasance

- Health and safety
- Information
- Litigation
- Natural disasters
- Operational
- Political
- Regulatory

Many agencies develop a risk register that itemizes the risks, describes the likelihood of a risk occurring, and identifies the impacts of each risk and potential mitigation strategies for an asset class. This refinement of an Asset Management Plan can occur at any time during plan development.

For more information and links to example risk registers, refer to Chapter 12: Risk Management.

What are the best O&M and CIP strategies?

Determine Appropriate Maintenance: Age-based and condition-based maintenance (CBM) strategies triggers maintenance when the age or condition or performance of an asset exceeds an upper limit, drops below a lower limit, or trends in a prescribed manner. A CBM policy necessitates uniform condition inspections at uniform intervals. An important factor to consider in determining the optimal maintenance policy is the likelihood and consequence of asset failure.

Lifecycle Planning and Prioritization: This section of the Asset Management Plan highlights an agency's process for managing asset lifecycle; a strategy for managing a group of assets, maintaining a specific level of service and performance, and minimizing costs. The value in selecting the best maintenance strategy is not just lower maintenance cost. Other potential benefits are lower total asset lifecycle cost and greater asset availability, reliability, and performance. In some cases, the greater benefit of one maintenance strategy over the other lies in the cost avoidance.

Lifecycle planning includes a description of the process behind the management of each asset as well as how data supports and informs decisions. Lifecycle planning is done at the asset group, or sub-group level, and considers the following for each asset type:

- Replacement cost

- Expected performance or condition assessment over time (by asset or individual component)

- Desired level of performance and risk associated with loss or reduction in asset performance

- Maintenance strategies and impact on deterioration rate

- Maintenance costs

- Sustainability and environmental considerations of maintenance, rehabilitation, and replacement

For more information, see Chapter 11: Maximizing the Value of Asset Investments.

For more information, refer to LRRB Report Manual 2016-34B, which is a Systems Preservation Guide that serves as a step-by-step guide to help address the transportation system preservation needs of an agency. The purpose of the System Preservation Guide is to demonstrate useful methods to address preservation needs at the local level. *www. dot.state.mn.us/research/TS/2016/201634B.pdf*

The manual is structured into five areas that act as a decision tree. It is a compilation of research and system preservation strategies identified as part of a larger study (Systems Preservation Guide: A Planning Process for Local Government Management of Transportation Networks) prepared by the Local Road Research Board. *www. dot.state.mn.us/research/TS/2016/201634A.pdf*

For each asset, starting with the most critical, ask four questions to help determine a maintenance strategy:

- What does this asset do?

- What happens if it fails for any reason from negligence to catastrophic?

- What is the probability of failure?

- What is the best maintenance policy or strategy that balances the on-going cost of the maintenance strategy, the risk, and the associated benefits?

After the optimal maintenance policy or strategy is determined, use it to build your maintenance manual. The maintenance manual can be a guide or simply an embedded table with specific itemized lists of instructions on how to keep each asset or asset type at or above desired performance standards.

Content of a Maintenance Manual

- **What:** The inventory of assets that must be maintained

- **How:** The types of maintenance tasks

- **When:** The intervals at which each asset is to be maintained. Also called the maintenance schedule.

- **Who:** The skill levels required for each maintenance task.

Determine Appropriate Capital Improvement Program: Use the data compiled, including inventory, condition, age, performance target service levels, risk, and available and anticipated funding, to create a strategic plan for maintenance and replacement of an asset or group of assets. Consider "how much money do I have to invest?" in determining the performance target service level and investment plan for future annual expenditures that are realistic.

With respect to funding annual maintenance activities to achieve performance target service levels, start with the most critical assets to sustain performance, determine the optimum maintenance requirements for each of these assets, and then allocate the available resources (both financial and human) required to implement the annual maintenance plan.

What is the best funding strategy?

Financial Plan and Investment Strategies: In the financial and investments strategies section of an Asset Management Plan (AMP), an organization should describe existing revenue sources and trends, inflation, investment strategies, potential new revenue enhancements (bonds, federal and state grants or loans, franchise fees, wheelage tax, local option sales tax, etc.), and funding gaps that prevent achieving performance targets. Outline the allotment of capital assets and public funding according to the prioritized list of projects. The plan should include the source of the funding as well, whether it is from a government grant or from the agency's own funds.

The *AASHTO Transportation Asset Management Guide Executive Summary* also provides information and resources for financial planning and performing lifecycle and risk analysis. The information provided in this document is targeted at states but could also be used by local agencies in considering the components of their plan.

An Asset Management Plan can evolve into a long-term financial planning tool which will help you identify what your priorities are, what you can or can't afford, and any challenges or obstacles needed to realize your desired performance levels of service. It will help your agency to look beyond the annual budgeting process and supplement it with a long-term management plan.

With budget constraints likely to remain tight for the foreseeable future, a long-term financial plan will help an agency determine which objectives are feasible, which are the most important, and if you are going to be able to maintain your priority assets over the long term within existing funding constraints. The financial plan of the AMP will help guide the agency's Capital Improvement Program (CIP). The CIP is often a 5-year plan which shows preservation, replacement and new projects along with their funding sources and funding gaps as applicable.

Paying for projects identified in a Capital Improvement Program (CIP) can pose a financial burden for any agency. Each agency will approach financial planning and funding for infrastructure assets based on what it deems to be in its best interest. The AMP provides data to make sound recommendations to policy makers.

So, how should local agencies program infrastructure asset investments to meet their documented level of service and performance targets? Asset management principles suggest the following:

Preserve what you have in a smart way. In other words, maximize the value of your current assets by minimizing their lifecycle cost. Use the AMP to prioritize lower cost, high benefit maintenance and preservation treatments that extend the life of the assets and minimize lifecycle cost. These projects should be programed first using available funding streams. Neglecting to fund these will cost the agency considerably more in the long term as illustrated in Figure 4.1. Assets that have reached or are approaching their useful life and need replacement should be programed next with any remaining funding. New or enhancement projects then compete for remaining funds and new revenue. Again, the AMP will help agencies make data driven funding decisions. Policy makers, administrators and finance directors can plan future budgets to meet performance targets. Funding shortages are identified so that agencies can determine strategies to fully fund the most important projects. Agencies have several options to pay for these projects including applying for grants, increasing revenue (taxes, fees, assessments etc.) or financing projects using capital bonding. The agency will need to weigh the drawbacks and benefits of pay as you go versus increasing revenue or financing using capital bonding. A combination of pay as you go and financing is often the best approach depending on market conditions.

The League of Minnesota Cities (LMC) and the Association of Minnesota Counties (AMC) both provide guidance to their members on local agency funding options for capital improvements.

How to begin implementation?

Implement, Accountability, and Process Improvements: Asset Management Plan creation typically concludes with a discussion of implementation, accountability, and continuous improvements. This section can convey priorities and highlight the organization's implementation strategy. Major priorities can be summarized by referencing the condition, performance, lifecycle, risk, and funding data developed in earlier sections of the plan. This section provides an opportunity to document implementation timelines, share lessons learned, and provide the vision for the future state of the system.

Report Results: Measure and record data to quantify results and track condition and progress over time. Monitor results of condition surveys for each asset over time to justify a continued path, or encourage modifications of the Asset Management Plan. Periodically report the results to stakeholders, preferably not less than annually.

The Local Agency Guidelines for Developing an Asset Management Process and Plan (published by the Michigan LTAP) provides insight into this element of the plan.

For more information, see Chapter 13: Signs of Successful Implementation.

DO I NEED ASSET MANAGEMENT SOFTWARE?

8

Asset Management Information Systems: Before considering the purchase of asset management software it is important to remember that asset management is not something that can be purchased. Asset management is not a software application; it is the process of using data, tools, and standard practices to more effectively manage assets.

The need and desire of both public agencies and private businesses to better manage their assets has resulted in the development and utilization of Asset Management Information Systems. An Asset Management Information System (AMIS) is a collection of hardware, software, data, and processes that support asset management business processes. An AMIS is used to collect, process, store, and analyze information about assets; to develop sound maintenance and rehabilitation strategies; and to schedule, track, and manage work. An AMIS will typically include:

- Technical information about asset characteristics, condition, and performance

- Financial information concerning current asset value and the level of resources needed to maintain and improve assets to meet established goals and service-level standards

- Historical information about work accomplished, investments made, and associated costs

Systems can range in sophistication from simple spreadsheets that list assets and their condition ratings to more complex, graphical systems with data maintenance, simulation, optimization, and reporting capabilities as illustrated in **Figure 8-1**. Systems for major assets with long lifecycles,

such as pavements, bridges, water and sewer mains, merit greater levels of sophistication because they support decisions about significant capital investments. Systems with lower capital value and shorter lifecycle assets, such as pavement markings, guardrail, or signs, can be simpler and more focused on maintenance planning and management.

Spreadsheet, Database, and/or GIS

Sophistication Level: **Simple**
Modeling and analysis capabilities are limited
Addition of GIS allows for customized maps
Investment Level: **$**

Public Domain Software

Sophistication Level: **Moderate**
Has some basic capabilities to model future conditions
Provides a variety of simple analysis scenarios and reporting methods
Investment Level: **$$$**

Private Domain Software

Sophistication Level: **Advanced**
Uses agency-specific models to predict future conditions
Provides the most robust analysis and reporting capabilities
Investment Level: **$$$$$**

Figure 8-1 Characteristics of varied levels of managing asset data. Source: Asset Management Guide, Indiana Local Technical Assistance Program (June 2017)

The common functional elements of an AMIS are:

- Asset inventory
- Asset condition, performance, and utilization tracking
- Asset condition and performance prediction
- Treatment selection
- Resource allocation
- Work planning and tracking support
- Database
- Links to geospatial features
- Application software
- Interfaces
- Field data collection system

Asset Management Information System Software: Software options range significantly in price and functionality from inexpensive applications like programmed spreadsheets to more costly and integrated software suites as illustrated in **Figure 8-2**, which can incorporate any data from inventory, condition, financial, maintenance activities, asset lifecycle, and work orders.

The Federation of Canadian Municipalities has prepared the *Guide: Questions to Ask Before Your Municipality Considers Asset Management Information System Software*. Two basic questions are:

1. Do we need it?
2. Are we ready for it?

Most Minnesota agencies that responded to the MN2050 survey reported using common tools for asset management that include Microsoft Excel (37%), ESRI GIS database (26%), and pencil and paper (25%) to manage their infrastructure. In all, more than 100 different software systems are being used across the jurisdictions to manage their different types of infrastructure assets.

In Minnesota, there are local agencies creating robust data models to support asset management. An agency does not need to reinvent the wheel, before creating individual data models, agencies should seek information on existing data models and their respective rating standards. Using an existing data model can save time and money. Most of the data structure will be defined, and a user can choose to extend the model or cut attributes

DATA

| Asset Inventory | Asset Condition | Work History | Programs and Budgets |

FUNCTIONAL COMPONENTS

Inventory Management	Condition, Performance and Utilization Tracking	Condition and Performance Prediction	Work Planning and Tracking Support
Database	Application Software	Field Data Collection System	Interfaces

TECHNOLOGY COMPONENTS

OUTPUTS

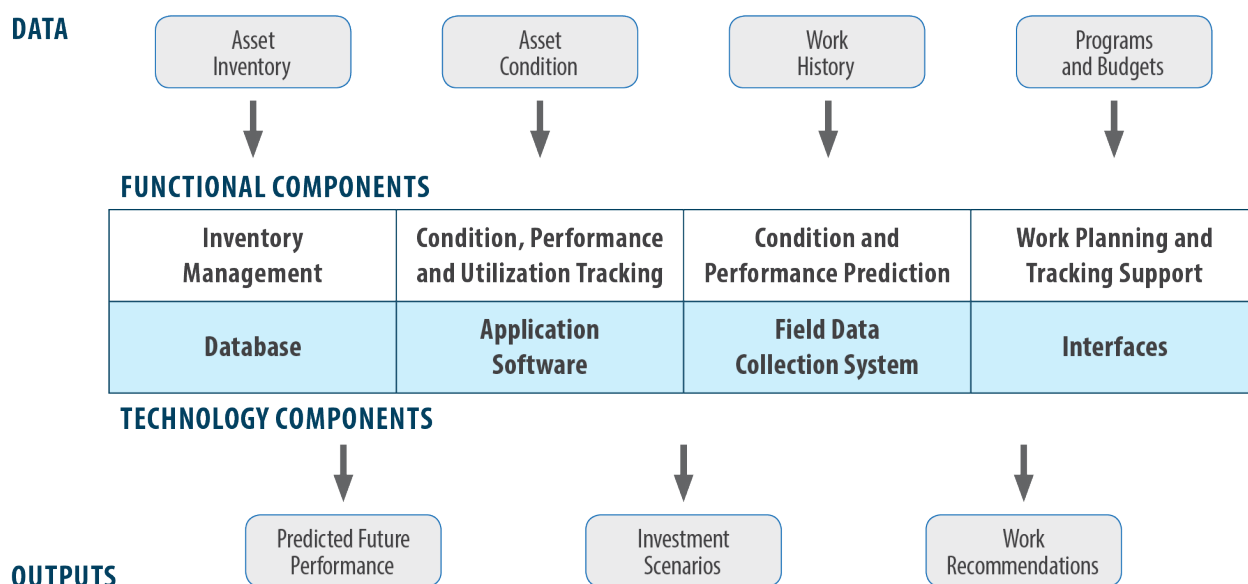| Predicted Future Performance | Investment Scenarios | Work Recommendations |

Figure 8-2 Data, Functional, and Technology Components of a Transportation Asset Management Information System. Source: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

to suit their organization. Adopting an existing rating standard whenever possible can also help with data sharing.

Asset management tools can be as basic as maintaining an inventory of assets with conditions in a Microsoft Excel spreadsheet, database, or a GIS mapping tool or include sophisticated software that automates budgeting and forecasting. The process of asset management deals with many thousands of records, and software can organize the data and help predict asset deterioration. This can be used to make data-driven decisions. It is important to note that software does not make decisions – its purpose is to inform the decision-maker. By incorporating financial data, software tools can enable users to explore the relationship between cost and performance.

Before considering the purchase of asset management software, consider the following:

- Organization
  - Is the organization prepared for change?
  - What staffing is required? Is current staffing sufficient?
- Needs and goals
- Existing resources
  - Can existing agency software investments be used for asset management?
  - Can asset software for one type of asset be used for different asset types?
- Budget
  - Am I getting what I pay for?
  - Can the short-term investment maximize your short-term benefits?

If you decide to purchase software, evaluate the following:

- End-user experience
- Flexibility/expandability
- Mobile capabilities
- Work order/stakeholder request management

- GIS integration
- Data extraction/integration
- Inspection/condition ratings
- Analysis/reporting
- Staff training and user groups
- Technical Support

Respondents of the MN2050 State of the Infrastructure survey noted the following reasons for selecting a specific asset management software:

- Ease of use
- Staff skills and capacity to use the system
- Cost
- Amount of time required to set up and populate the system components and databases
- Whether the system requires the assistance of an outside consultant to implement and keep updated.

Just as agencies can collaborate to develop data standards, they can also collaborate on software. Some agencies have formed software-specific local or regional user groups to share knowledge and best practices. An example of collaboration is the fleet management software partnership between Carver County, Scott County and the Cities of Burnsville, Shakopee, Carver, and Apple Valley. Scott County is the lead agency, and all the asset data is hosted on the AssetWorks servers for each of the collaborative partners. Carver County lists the following benefits of a partnership like this one:

- Local partners
- Shared costs of training
- Access to a high quality product at a lower cost than if purchased separately
- Ability to learn from each other
- Opportunities to expand and grow
- Shared IT support services

Another consideration is to take advantage of software developed through state LTAPs, colleges,

universities, and other governmental agencies that may address the issues small rural counties have with asset management implementation, such as cost, staffing, technical expertise, and IT support.

This guide does not recommend or support specific software, and LRRB has completed several reports summarizing pavement management and other software products. The RIC also recently completed a report describing fleet management systems, and many of the tools available will also manage other assets. These resources are available on the _LRRB website_.

Asset management systems and software can help your agency accomplish many of your Asset Management Program goals and objectives, but it cannot make decisions for you!

DATA MANAGEMENT

9

Before an asset inventory is created, consider how data will be managed and stored; several options are available and represent a range of costs and sophistication. Asset management relies on accurate and up-to-date data, and it is important to establish protocols to ensure data consistency, integrity, and security.

Some information changes regularly and other information does not. As each type of data is classified, establish procedures for updating it. For example, information about the functional classification of a road does not change regularly – after data is established in the inventory, it likely will not need to be frequently revisited. Other information, like construction and maintenance data, will change periodically and must be updated more frequently.

Few agencies can obtain all the data needed to initially manage all their assets so developing a long-range plan that prioritizes the data collection and

formatting is key. Using GIS in conjunction with each tool for location and mapping allows spatial data such as condition data, maintenance activities, and work orders, to be stacked, displayed, retrieved, analyzed, and presented in an interactive graphical map display. MnDOT has their entire roadway inventory information managed within GIS, with different layers used to store and display the various types of data. Most Minnesota cities and counties also have access to and use GIS.

Data quality has a direct influence on project and maintenance treatment recommendations, especially its consistency and reliability. Because it is so important, use a quality control process to check for routine data errors such as missing data, data that does not make sense (e.g., improvements in condition without work having been performed), or data outside normal data ranges (e.g., pavement width > 30 feet on a two-lane rural road).

Data and accessibility

Data collection and maintenance can be one of the most expensive and time-consuming parts of developing an Asset Management Program. Timely and accurate data collection is critical to success.

Before proceeding with data collection, ask the following questions:

- What is the quality of existing data?
- What deficiencies need to be corrected or updated?
- What is the budget and schedule?
- What is the immediate need?

- What will be the future use and analysis of the data?
- How accurate must the data be?
  - Is elevation important?
  - Do we have the appropriate equipment to collect or achieve the desired accuracy?
  - What is your data quality control plan?
- Who will collect and process field data?
- How and by whom will data be uploaded, maintained and updated?
- Is there an existing data model or standard we can use?

Data models and standards

MetroGIS is a voluntary collaboration of local and regional governments in the seven metropolitan counties of the Twin Cities that provides a regional forum to promote and facilitate the widespread sharing of geospatial data. Teams of subject matter and data experts gather and contribute many hours to create data models that can be used to provide a common schema. Examples of data models are roadway centerlines, parks and trails, and stormwater. These GIS models are openly available, and any organization can deploy them rapidly by simply downloading the model to plug it into their GIS network and begin collecting data. Data standards or models can originate from many other sources as well such as the State of Minnesota, professional organizations, larger cities or counties, or even subject matter experts in smaller communities.

There is a strong movement from the global to local levels to provide free and open data; government open data is consumed by other agencies, private sector companies, and the public in new and innovative ways. Agencies must assess the risks of sharing asset data, as some data may be shared publicly, but critical infrastructure must be protected.

Time and effort required

How much time does it take to effectively manage an asset? The answer to that depends on many factors. The Indiana DOT guide provides some insight into how much effort data collection will take. Every asset is unique, but one Indiana city was able to use street centerline maps from GIS in a tablet application for collecting PASER. Their process was considered very efficient, with three teams able to collect the road ratings for 34 centerline miles over a four-day period. A city with just more than 100 miles in its network was able to collect the data at a rate of about two to three miles per hour in the field. Objectively consider the type of data that is important before setting out to collect it; take care to select the right data as well as the right amount.

Measuring current asset conditions

The most important thing to know about assets is their condition. Objective condition ratings serve as a valuable tool for two purposes: (1) collected data allows the user to monitor condition over time and (2) the data can be used to communicate performance to agency leadership and constituents. Prioritization and decision-making based on asset condition value is defendable and easy to communicate. Condition information and performance data also increases accountability by demonstrating what is accomplished with each funding cycle and helps an agency quantify and strategically mitigate risk.

Various condition rating systems, methodologies, and tools have been developed for almost every conceivable asset type. ASCE's Infrastructure Report Card is based on a set of eight criteria. The Indiana DOT's PASER rating method for pavements is detailed in the *Indiana LTAP Asset Management Guide*. The U.S. Army Corps of Engineer's Paver and APWA's MicroPAVER are very robust and widely used software applications using well established rating systems. Paver FieldInspector™ is a MicroPAVER™ companion software that takes advantage of GIS/GPS state-of-the-art technology as well as innovative graphics to facilitate pavement inspection using handheld computer tablets.

Regardless of the system, methodology, or tool you choose, strive to keep your data current. Avoid collecting information that is difficult to maintain or not useful in making treatment or investment decisions. It is better to do a good job maintaining a small amount of useful information about the asset than having a comprehensive inventory that is constantly out of date because an agency does have the resources to keep it current.

Figure 9-1 is a basic pavement rating system example you can use to get started. Your rating system can be as simple as good, fair, or poor.

Figure 9-1 Example of progression of deterioration from good to poor. Source: Asset Management Guide, Indiana LTAP (June 2017)

Listed below is an example of a tiered system that is widely used for measuring the condition of many asset types:

- **Excellent.** Only normal scheduled maintenance is required.

- **Good.** Some minor repairs needed; functions okay.

- **Fair.** More minor repairs required; mostly functional.

- **Poor.** Significant repairs required; system not fully functional for use.

- **Critical/Bad (Very Poor).** Major repair or replacement required to restore function; system unsafe.

CAD and asset data collection

Most infrastructure data that is currently mapped (automated) during the lifecycle of engineering plans and as-builts is in CAD format, which can be converted directly into GIS format. Also, any infrastructure asset database stored in GIS can be directly converted into CAD format. Data collection activities (i.e., collecting maps and attribute data) for many different types of infrastructure such as watermains and sewer lines are analogous and do not have to be reinvented.

TAKING ASSET MANAGEMENT TO THE NEXT LEVEL

10

AASHTO and MnDOT both provide great guidance documents for the development of a Transportation Asset Management Plan (TAMP) for agencies ready to move to this level of sophistication. In addition, the National Cooperative Highway Research Program (NCHRP) has researched and created asset management guidance documents. Minnesota local governmental agencies are **not mandated** to create a TAMP like local agencies in Indiana and Michigan and do not have mandated TAMP elements. The following provides additional information and links to TAMP examples and resources.

Transportation Asset Management Plan (TAMP): The TAMP is an essential management tool that brings together all related business process and stakeholders, internal and external, to achieve a common understanding and commitment to improve performance. It is a tactical-level document that focuses on analytics, options development, programs, delivery mechanisms, and reporting mechanisms on ensuring that strategic objectives are achieved.

NCHRP has created an outline using the [Transportation Asset Management Plan (TAMP) Builder](#) website and tool. The site provides resources to customize templates to meet agency specific objectives and requirements.

A TAMP formalizes and documents key information including:

- Strategic outcomes or objectives that it supports
- Service that the agency delivers now, and in the future, and why it is delivered

- Nature of the assets required to deliver the services and their current condition and performance in a form relevant to assessing the achievement of the agency's mission
- Planned asset improvements and capacity expansion in response to future demand, risk, and other trends
- How the assets will be cost-effectively managed throughout their lifecycles
- Long-term financial forecasts, thus informing program development and budget cycles
- Planned productivity in asset management business processes, goals, and requirements for resource availability and productivity, and desired performance resulting from implementation of the plan.

AASHTO Guidance: The *AASHTO Transportation Asset Management Executive Summary* serves as a companion to the *AASHTO Transportation Asset Management Guide – A Focus on Implementation*, which takes the *Transportation Asset Management Guide* published by AASHTO in November 2002 as a starting point. All three documents should be read and used together, as they are complementary.

The *AASHTO Transportation Asset Management Guide* provides considerable background information about Transportation Asset Management (TAM), advantages of using TAM, and an approach that agencies can use to identify where they are now and where they should focus their asset management efforts.

AASHTO's Transportation Asset Management Guide: A Focus on Implementation is presented in three key parts:

1. Organizing and leading TAM, which may be of most interest to executive management.

2. Processes, tools, systems, and data, which may be of most interest to practitioners.

3. Appendices that include examples of Asset Management Plans and four in-depth case studies of the TAM implementation experiences of local and international agencies.

The guide is a step-by-step presentation, as illustrated in **Figure 10-1**, of the tasks to implement asset management in a transportation agency. It is structured so that a reader can use a section or topic as a source of advice (typically a practitioner) or use the whole in order to drive a systematic agency-wide implementation. Chapters 1 through 4 provide the context and preparatory steps that any agency will need to undertake as it prepares for asset management implementation. The material in these chapters is broadly applicable to agencies at any level of maturity. In Chapter 4, differences emerge among agencies at varying levels of maturity, as the more advanced agencies will typically have more formalized and extensive TAMPs in place. Chapters 5 to 8 are designed to be used selectively, depending on the priority areas of improvement identified by the gap analysis in Chapter 2. These later chapters are focused on the specific tools, methods, and information technology resources required to reach the more mature stages. The most experienced asset management agencies use all the tools described here. However, it is important not to be overwhelmed by their breadth and depth. Agencies climbing the maturity scale who might not use many of these tools today, can set their own priorities for near-term implementation activities.
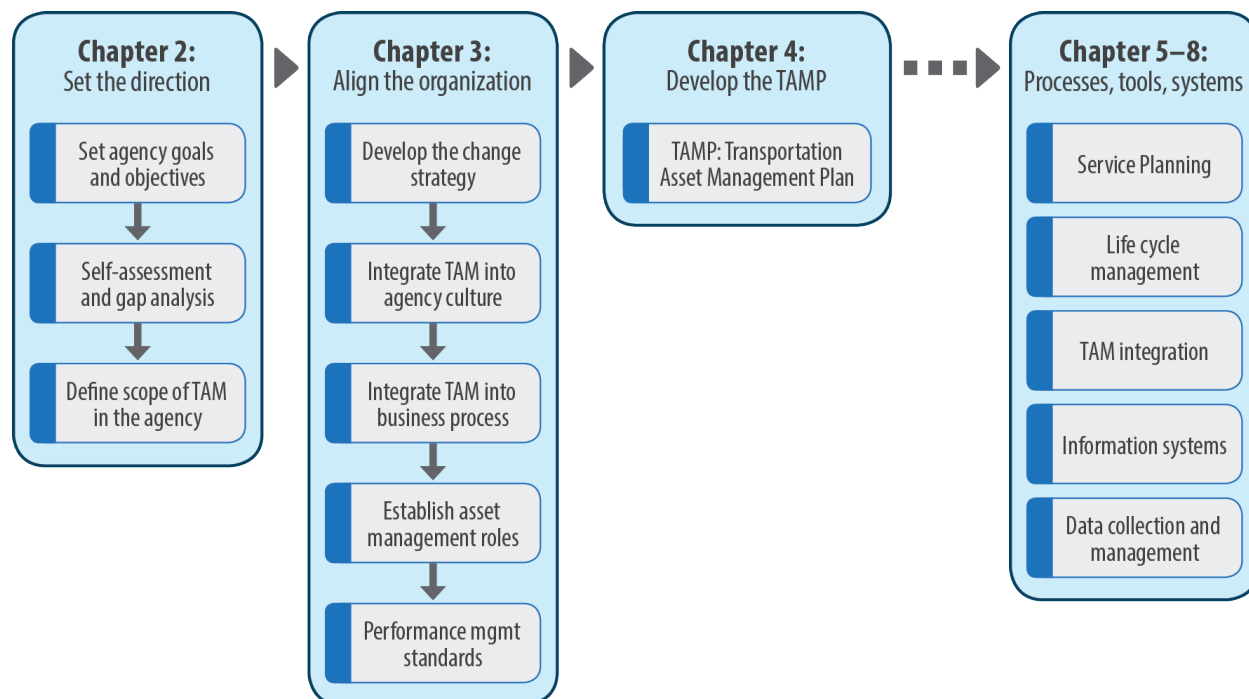

Figure 10-1 Transportation Asset Management Plan (TAMP) implementation steps. Source: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

MnDOT Transportation Asset Management Plan: The Minnesota Department of Transportation was one of three states selected by the Federal Highway Administration to participate in a pilot program to prepare a TAMP as an example and guide for other state DOTs. Although MAP-21 legislation focused on the development of a TAMP for bridges and pavements on the National Highway System, MnDOT elected to expand the TAMP beyond these requirements to also include pavements and bridges on the entire state highway system as well as highway culverts, deep stormwater tunnels, overhead sign structures, high-mast light tower structures, signals, lighting, ITS, noise walls, buildings, and pedestrian infrastructure.

For more information go to *www.dot.state.mn.us/ assetmanagement/tamp.html*

ASSET MANAGEMENT USING LIFECYCLE COST ANALYSIS

11

The focus of infrastructure asset funding has been shifting towards system preservation, and the development and use of an Asset Management Program by local agencies has and will continue to provide opportunities for decision-makers and policymakers to make more informed long-term investment decisions. Analysis of the collected data requires both a short-and long-term look at the needed investment costs to ensure the sustainability of and funding for the asset.

ASCE, in a paper titled, *Maximizing the Value of Investments Using Lifecycle Cost Analysis*, states that "lifecycle cost analysis is a data-driven tool that provides a detailed account of the total costs of a project over its expected life." ASCE research indicates that, in the past, there has been little incentive for the public sector to use Lifecycle Cost Analysis (LCCA). The paper is intended to help policymakers gain an understanding of the potential benefits of LCCA, the barriers that exist to its implementation and use in the public sector, and

approaches and case studies that can be used to overcome those barriers.

The U.S. Department of Transportation published a *Lifecycle Cost Analysis Primer* that provides a background for users to investigate the use of lifecycle cost analysis to evaluate alternative asset investment options. The primer also demonstrates the value of such analysis in making economically sound decisions.

Preservation strategies and activities are different from traditional maintenance and rehabilitation activities. Traditional approaches address existing deficiencies, and many preservation activities are performed before deficiencies occur. Preservation activities delay the degradation of the value of the asset and increase the useful life of the asset. LCCA provides a means to evaluate the economic effectiveness of preservation activities through total lifecycle costs comparisons.

Incorporating lifecycle cost analyses into your asset management program

What is the full cost of investing in an asset? It is the total cost of the asset and can include design, construction, operations, maintenance, and disposal. Comparing project design alternatives by just the initial costs can lead to shortsighted decisions.

Here are several applications that could use LCCA:

- Helping select the most effective alternative to meet a project objective, such as replacing a bridge.
- Evaluating a design requirement within a specified project, such as pavement types.

- Comparing overall costs between two different types of projects to help prioritize limited agency funding.

Tools and models have been developed and used within the highway and other industries to estimate lifecycle costs and provide a mechanism to compare alternatives.

LCCA is not a foolproof prediction of the future. The principle risks of failure are predicting the time horizons for asset investments and the prediction of future costs.

The LCCA approach enables a total user and agency cost comparison of competing preservation alternatives. LCCA is a subset of benefit-cost analysis, an economic analysis tool that compares benefits as well as costs in selecting optimal projects.

The opportunities for lifecycle cost reduction are typically greatest in the planning stage where many of the factors, such as scoping, option evaluation, and design section, that affect lifecycle costs are decided. After the asset is built, the focus becomes managing and maintaining the asset; doing the right work at the right time to get the best value in terms of the asset's performance and the services the asset delivers. **Figure 11-1** contrasts the total accumulated life-time costs of a typical asset with the opportunities for lifecycle cost reduction.
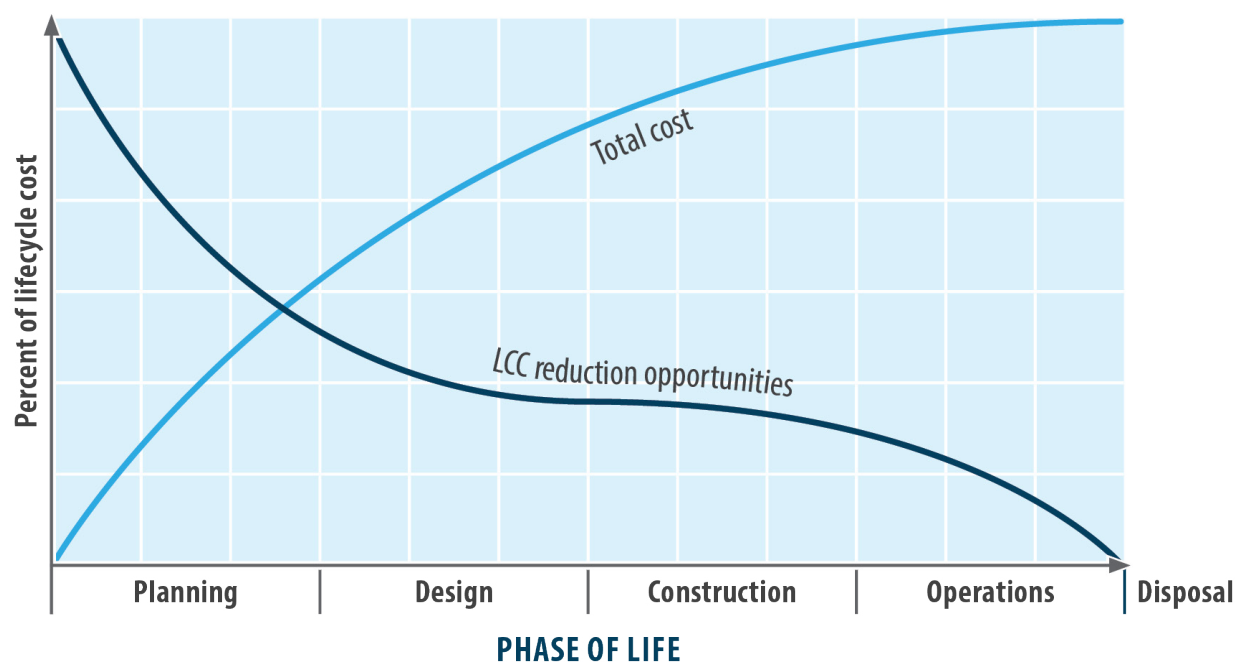

Figure 11-1 Asset Lifecycle Costs and Decision-Making Opportunities. Source: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

Lifecycle planning and prioritization

This section of the AMP highlights an agency's process for managing asset lifecycle; a strategy for managing a group of assets, maintaining a specific level of service, and minimizing costs.

Lifecycle planning includes a description of the process behind the management of each asset as well as how data supports and informs decisions. Lifecycle planning is done at the network level, asset group, or subgroup level, and considers the following for each asset type:

- Replacement cost

- Expected performance or condition assessment over time (by asset or individual component)

- Desired level of service, and risk associated with loss or reduction in service

- Maintenance strategies and impact on deterioration rate

- Maintenance costs

- Sustainability and environmental considerations of maintenance, rehabilitation, and replacement

Figure 11-2 is from the *AASHTO Transportation Asset Management Guide* Executive Summary and outlines a process for conducting lifecycle planning.
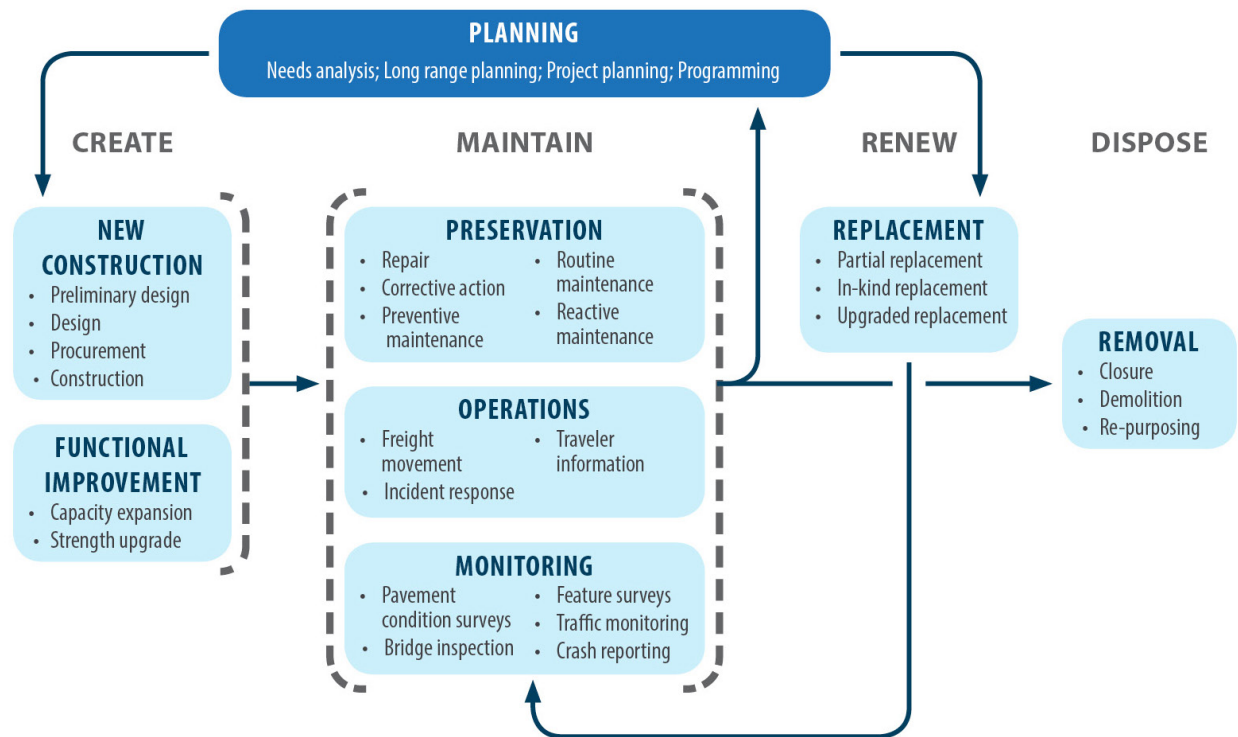

Figure 11-2 Process for Conducting Lifecycle Planning. Source: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

RISK MANAGEMENT

<div style="text-align:right">

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In 2009, the International Organization for Standardization (ISO) published "*ISO 31000 Risk Management – Principles and Guidelines,*" which defines risk as "the effects of uncertainty on objectives."

Risk can reduce the effectiveness of an agency and the decisions it makes. By creating a risk management program, an agency can reduce threats to the public. Risk management complements asset and performance management. It also helps an agency develop mitigation strategies and achieve their strategic objectives.

The AASHTO Transportation Asset Management Guide illustrates the relationship between strategic objectives, asset management, and performance management in **Figure 12-1**, with risk management being at the center of the three:

Examples of agency risks are listed below:

- Health and safety
- Operational
- Economic
- Political
- Regulatory
- Information
- Natural disasters
- Fraud or malfeasance
- Litigation

Figure 12-1 Relationship of risk management to transportation agency management. Source: https://international.fhwa.dot.gov/scan/12029/12029_report.pdf

Many agencies develop a risk register that itemizes the risks, describes the likelihood of a risk occurring, and identifies the impacts of each risk and potential mitigation strategies for an asset class. The *AASHTO Transportation Asset Management Guide* included the table below as a way to model risk likelihood and consequence for an agency:

LIKELIHOOD	CONSEQUENCE				
	Insignificant	Minor	Significant	Major	Catastrophic
Very Rare	Low	Low	Low	Moderate	High
Rare	Low	Low	Moderate	High	High
Seldom	Low	Moderate	Moderate	High	Extreme
Common	Moderate	Moderate	High	Extreme	Extreme
Frequent	Moderate	High	High	Extreme	Extreme

Figure 12-2 Risk Likelihood and Consequence Categories. Source: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

In addition, AASHTO has published the "AASHTO Guide for Enterprise Risk Management" and a free Quick Guide that provides a useful overview of risk management for transportation. It can be found *online*.

This Guidebook provides the following reference links on how to conduct a risk management analysis and develop a risk register for your agency.

- Chapter 5 of MnDOT's Transportation Asset Management Plan (2019)
  - http://www.dot.state.mn.us/assetmanagement/tamp.html

- Page 17 of the Transportation Research Board's NCHRP08-36(126)
  - http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP08-36(126)_FR.pdf

SIGNS OF SUCCESSFUL IMPLEMENTATION

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What makes an Asset Management Program successful? The answer may be as simple as tracking the condition of an asset over time and watching its condition and value change based on investment and maintenance strategies.

Ongoing communication is essential to the success of an asset management program and plan. Asset management implies change and change in an organization can be difficult to manage. Getting management and staff commitment is essential for the successful adoption of asset management philosophy and principles. For the people within an organization to cooperate and participate in change it is vital they understand the reasons and benefits of the change.

Communication is important because of the involvement of different disciplines and levels within an organization that typically have different perspectives about the agency assets. Asset management policies, practices, and procedures when effectively explained can take some of the mystery out of how and why asset investment decisions are made. Goals and strategies must be clearly articulated using terms that are meaningful to stakeholders.

Documenting the asset inventory and current conditions and estimating future conditions based on alternate investment strategies and performance measures leads to transparent decisions. Public confidence in an agency's performance is achieved by reporting results, accomplishments and failures, and documenting progress toward established goals.

The asset management program should clearly communicate:

1. What we are doing?

2. Why we are doing it?

3. How we plan get it done?

4. Where we intend to do it?

5. When will it be accomplished?

How can you measure the success of your asset management initiative?

NCHRP Report 866, "Return on Investment in Transportation Asset Management Systems and Practices" outlines a framework for developing the Return on Investment (ROI) resulting from Asset Management Plan implementation. This NCHRP included costs associated with those systems, including initial system purchase, improvements to an existing asset management system, and enhancement of an agency's data collection and reporting methods.

Consider the following checklist:

☐ **Did your agency achieve the expected benefit from creating an asset management program and plan?**

– You decided to do this for a reason! Did you achieve the specific benefit(s) you envisioned and set forth in your asset management program objectives?

☐ **Did your agency take the right approach to developing an asset management program and plan?**

– Asset management implies change and change in an organization can be difficult to manage. During the process staff relationships may have become strained and the organization may have experienced some level of chaos. Did everyone eventually pull in the same direction or were the asset management advocates always having to push the initiative forward? Did the approach build a stronger team and organization that will enable future collaboration?

☐ **Was your data credible and current?**

– The merits of being able to objectively review and consider different asset investment options that are based on credible and current data builds staff and public confidence in your agency's decisions.

☐ **Did you monitor and report the performance results of the asset(s)?**

– Performance results should be monitored and reported for both impacts and effectiveness. Are the investment decisions you made showing performance and condition trends heading in the right direction? If not, why not? If so, what must you do in going forward to maintain those trends?

☐ **Has your agency been able to sustain the change to data-driven, performance-based decision-making that comes from asset management?**

– The last metric when looking at how to measure success is how the change "gets made and stays made". Is your agency's "new normal" for allocation of resources one that is that is data-driven, performance-based decision-making? Is it in regular use across the organization?

Delivering a sustainable change is the overall legacy of your asset management program and plan!

APPENDIX A: ALPHABETICAL REFERENCE LISTING BY SOURCE

AASHTO

- *AASHTO Transportation Asset Management Guide A focus on Implementation*
  - https://www.fhwa.dot.gov/asset/pubs/hif13047.pdf

Alberta, Canada

- *Getting Started Toolkit User Guide*
  - http://www.municipalaffairs.alberta.ca/documents/ms/2015-11-18_Toolkit_-_FINAL.PDF

American Public Works Association (APWA)

- *Guide to Successful Asset Management System Development*
  - https://www.apwa.net/MyApwa/Apwa_Public/Resources/Guide_to_Successful_Asset_Management.aspx

American Society of Civil Engineers

- *https://www.asce.org*

American Water Works Association (AWWA)

- *https://www.awwa.org/Portals/0/AWWA/ETS/Resources/AMGuidebook.pdf?ver=2018-12-13-100101-887*

Federal Highway Administration (FHWA)

- *FHWA: Generic Work Plan for Developing a TAMP*

Federation of Canadian Municipalities

- *https://fcm.ca/sites/default/files/documents/resources/tool/asset-management-readiness-scale-mamp.pdf*
- *https://fcm.ca/sites/default/files/documents/resources/guide/how-to-develop-asset-management-policy-strategy-mamp.pdf*
- *https://fcm.ca/en/resources/mamp/guide-questions-ask-your-municipality-considers-asset-management-software*
- *https://fcm.ca/sites/default/files/documents/resources/guide/questions-to-ask-before-your-municipality-considers-asset-management-software-mamp.pdf*

Harvard Business Review

- *Beer and Nohria, Harvard Business Review, May 2000*

Institute of Asset Management (IAM)

- *Institute of Asset Management (IAM)*

Institute of Public Works Engineering Australia

- *www.ipwea.org/home*

Indiana Department of Transportation (IDOT)

- *Asset Management Guide*
  - https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1117&context=inltappubs

International Organization for Standardization (ISO)

- *ISO 55000 Standards for Asset Management*
  - *https://www.assetmanagementstandards. com/*
- *https://www.iso.org/standard/55089.html*

Local Road Research Board (LRRB)

- *https://lrrb.org/media/reports/TRS1603.pdf*
- *http://www.dot.state.mn.us/research/ TS/2016/201634B.pdf*
- *LRRB website*

Michigan Department of Transportation (MDOT)

- *Local Agency Guidelines for Developing an Asset Management Process and Plan*
- *https://www.michigan.gov/documents/mdot/ Which_Roads_To_Fix_437994_7.pdf*

Minnesota Department of Transportation (MnDOT)

- *Transportation Asset Management Plan*
- *Transportation Asset Management Plan Technical Guide*
- *http://www.dot.state.mn.us/assetmanage-ment/tamp.html*

MN2050

- *https://www.wilder.org/wilder-research/ research-library/mn2050-state-infrastructure*

National Cooperative Highway Research Program (NCHRP)

- *www.tamptemplate.org*
- *NCHRP Report 866, "Return on Investment in Transportation Asset Management Systems and Practices*

Purdue University (Indiana LTAP)

- *https://docs.lib.purdue.edu/inltappubs/118/*

Saskatchewan, Canada

- *Asset Management Getting Started Guide*
  - *http://www.publications.gov.sk.ca/details. cfm?p=80617*
- *https://www.youtube.com/watch?v=ag-P0LCPL4nw*

Southern Cross University

- *Brunetto, Xerri and Nelson, Southern Cross University 2014*

Water Environment Research Foundation

- *http://simple.werf.org/*

APPENDIX B: LIST OF FIGURES AND ACKNOWLEDGMENTS

Figure 3-1: Indiana Local Technical Assistance Program Asset Management Guide (June 2017)

Figure 4-1: SRF Consulting Group Chippewa County Highway System Report and Presentation (June 2017)

Figure 4-2: Canadian Province of British Columbia Asset Management for Sustainable Service Delivery: A BC Framework

Figure 5-1: APWA Guide to Successful Asset Management System Development (April 2018)

Figure 7-1: Federation of Canadian Municipalities The Building Blocks of Asset Management

Figure 7-2: Water Environment Research Foundation: *http://simple.werf.org*

Figure 7-3: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

Figure 8-1: Indiana Local Technical Assistance Program Asset Management Guide (June 2017)

Figure 8-2: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

Figure 9-1: Indiana Local Technical Assistance Program Asset Management Guide (June 2017)

Figure 10-1: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

Figure 11-1: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

Figure 11-2: AASHTO Transportation Asset Management Guide: A Focus on Implementation June 2013)

Figure 12-1: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

Figure 12-2: AASHTO Transportation Asset Management Guide: A Focus on Implementation (June 2013)

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