Local Agency Guidelines for Developing an Asset Management Process and Plan

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SPONSORED BY:

MICHIGAN TRANSPORTATION ASSET MANAGEMENT COUNCIL

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MICHIGAN DEPARTMENT OF TRANSPORTATION

MDOT Michigan Department of Transportation

PREPARED BY:

OPUS INTERNATIONAL CONSULTANTS INC.

OPUS

Local Agency Guidelines for Developing an Asset Management Process and Plan

How to use this document

Developing an asset management process and plan may seem like a very daunting task to an agency. However, it is vitally important for you and your agency to realize that many of the ideas, concepts, and or data collection tasks may already be part of your daily operations and culture. This document has been designed to lead you through the steps of an asset management process. Companion documents are the *Bridge Asset Management Guide for Local Bridges / Sample Bridge Asset Management Plan for Local Bridges* and the *Asset Management Plan for Pavements: A Template for End Users*. Completing the basic section of the pavements template will allow a city or village to achieve certification with the Michigan Department of Transportation (MDOT).

The asset management process provided in this document does not apply to any particular asset. The process can be applied to pavements, bridges, signs, etc. The document was specifically designed in this manner to allow the user the freedom to apply the same set of processes to any asset category where the user may wish to implement a more informed decision process. This document is accompanied by a sample asset management plan that has been tailored to pavements, and is complimented by the Michigan Bridge Asset Management Guidelines.

The first part of this document provides you with background information on asset management. It also provides a history of asset management practice in the State of Michigan. In addition to providing introductory information, the first part of the document provides a glossary of terms to be used throughout the document.

The second part of this document walks the user through the steps of establishing an asset management process and plan. Part two begins with a flow chart that illustrates the steps necessary for a basic asset management process and plan and provides the next steps an agency could take to achieve a moderate or advanced level of asset management. Each box in the chart corresponds to a section of part two and is directly tied to a section in the sample asset management plan.

Consider the starting figure in part two to be your map to asset management. Now that you have a map to where you are going, you can feel free to enjoy the journey to your new asset management process.

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Part A: Introduction to Asset Management

What Asset Management Can Do for You

Dear Colleagues:

The Transportation Asset Management Council is happy to provide this resource to local units of government and transportation agencies as part of our mission to promote the benefits of Asset Management. For several years, our focus has been on collecting important data on our road and bridge system and on recording the improvements. That is not going to stop. Continued data collection is key. However, it is now time to focus on using the data to develop road and bridge improvement plans that maximize the use of the dollars we have. Developing an Asset Management Plan for your community/agency can help you accomplish this.

We hope you will find this useful in developing your local asset management plan.

Carmine Palombo
Chairman
Transportation Asset Management Council

I. Introduction to Asset Management

A. What is an Asset Management Process?

There is no definitive answer to this question. Asset management is practiced differently by different agencies. At the most basic level asset management is a way to meet the goals of good ownership, effective management, and responsible stewardship.

In the State of Michigan, asset management has traditionally been applied to maintaining pavements. However, a typical transportation network also comprises bridges, signs, culverts, guardrail, etc. The principles of asset management should be applied to the management of all these components of the asset. Asset management represents more than simply an integration of existing management systems and data. It builds on existing processes and tools to form a continuous improvement guide that complements and supplements existing practice.

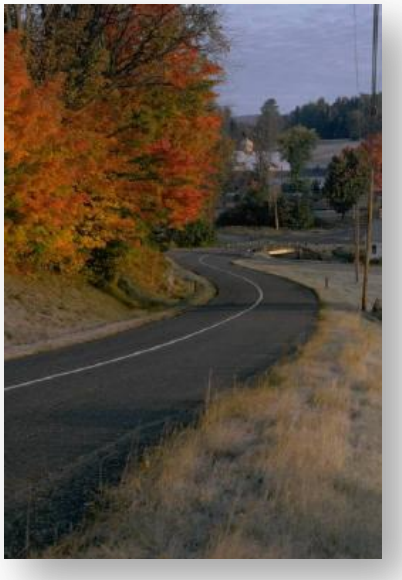
Asset management, as defined by Public Act 199 of 2007, is an "ongoing process of maintaining, upgrading, and operating physical assets cost-effectively, based on a continuous physical inventory and condition assessment."

The themes that define an asset management approach to operating and maintaining transportation infrastructure are as follows:

Policy Driven	The allocation of resources depends on a well-defined set of performance goals and measured results, which may reflect level of service, system conditions, and community goals.
Performance Based	Allows policy objectives to be translated into daily operations decisions and strategic maintenance decisions.
Quality Information	Accurate information regarding inventory, condition, and funding availability drives decisions that meet policy objectives and performance measures.
Mix of Fixes	A system-wide assessment is made to determine the most valuable alternatives to invest in current and future system performance.
Monitoring	The system will need to be continuously monitored to ensure the investments are meeting the policy objectives.

B. Why Asset Management?

It is widely accepted that transportation infrastructure is vital to the economic well being of our State. For most local authorities their road network is the most valuable community asset under their control. Despite this, there is a growing realization that the management of these vital and valuable assets is not receiving the attention or funding required for the provision of the optimal state of repair and operation.



Challenges Facing Public Agencies

Public agencies exercise their duties to operate, maintain, and improve their highway assets under increasing pressures that include:

- Inadequate budgets – with funding diverted to support services;
- Limited resources – both staff and skill shortages;
- Mature networks – with a significant backlog of required maintenance;
- Increase accountability – to customers and funding providers; and,
- Increasing public expectations – the public are increasingly informed and demanding.

Public agencies may be facing shortfalls in transportation funding so severe that they are unable to maintain the current condition of the system. These agencies may not consider developing an asset management plan a worthwhile investment.

Developing an asset management plan empowers public agencies to invest their scarce transportation funding in ways that will provide the greatest return. An asset management plan also allows a community to determine what an acceptable level of services is while informing residents and elected officials of the impacts declining transportation funding will have on the system.

Reasons to Choose Asset Management

Asset management can improve an agency's performance, cost-effectiveness, communication, accountability, and credibility. Specific outcomes include:

- Lower long term preservation costs of current assets;
- Improved cost-effectiveness and use of available resources;
- Improved communication with elected officials and the public about level of service vs. cost of service; and,
- Improved credibility and accountability for decision-making process and results.

C. Benefits of Asset Management

Some public agencies may question why asset management would be valuable to them even when presented with the preceding outcomes. It is important to consider why an agency would not choose to adopt an asset management approach, i.e. why would an agency not want to:

- Think strategically;
- Consider tradeoffs between alternatives;
- Establish performance goals and measure results;
- Consider the users; or
- Be able to substantiate funding requests with facts.

Agencies undertake the preceding items on a routine basis. Most agencies would recognize that an opportunity to improve their performance exists under one or more of these areas. Asset Management is a process that assists an agency in realizing these improvements.

Specific Benefits

Specific benefits of utilizing the asset management process are:

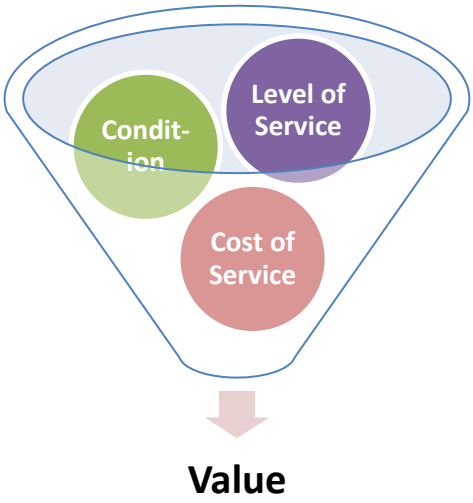
- Reduced life-cycle costs;
- Defined levels of service;
- The ability to track performance;
- Improved transparency in decision making;
- The ability to predict the consequences of funding decisions; and,
- The ability to meet the recommendations of Act 199 0f 2007.

These specific benefits are stepping stones to the public realizing a better value for their investment.

Better Value

Asset management facilitates better decision-making by supplementing instinctive engineering judgment with financial, economic, and engineering analysis. It thereby enables a public agency to better understand and manage the relationship between cost and performance.

A better understanding of this relationship will facilitate more informed discussions with the public and elected officials. For example, it will enable a road commission to document the effects of a short fall in funding and properly communicate that information to elected officials while empowering constituents to understand the effects of the legislature's decisions.



D. Purpose of the Guide

In Michigan, the term "asset management" is commonly used in relation to the management of pavement condition; however this term can apply to all assets.

Primary Purpose

This guide is intended to be a valuable reference for public agencies looking to implement asset management. It will also assist local authorities to share knowledge on the subject of asset management by providing common 'ground rules' and terminology. The guide promotes a deeper understanding of asset management principles that will allow public agencies to demonstrate prudent stewardship of their assets and better justify funding decisions.

Use of the Guide and Template

It is anticipated that the guide and accompanying asset management plan template will be used to:

Introduce the concepts of asset management	By providing a summary of the principles and benefits of asset management suitable for briefing senior managers, politicians, and customers.
Assist with the implementation of asset management	By providing a process-oriented reference to those wishing to introduce the principles of asset management to their management procedures.
Assist with the preparation of an asset management plan	Part B of this document facilitates the development of an asset management plan. The document provides guidance on use of the accompanying asset management plan template.

II. Asset Management in Michigan

A. History of Michigan Asset Management Legislation

Michigan began the asset management journey in 1998, when the Michigan Legislature established the Act 51 Transportation Funding Committee. The committee was charged with studying transportation funding issues and making recommendations for improving the way Michigan's transportation providers operated, maintained, and modernized their facilities. The committee determined that the tasks with which they were charged could not be performed until a system was in place to understand the current conditions of the infrastructure assets and how transportation resources were being allocated.

The committee's findings lead to a pilot project between the Michigan Department of Transportation (MDOT) and the County Road Association of Michigan (CRAM) to test the proposed asset management concepts. The pilot project successfully showed that a shift away from traditional needs studies for budgeting was justified. The pilot project also found that the PASER methodology for assessing pavement conditions could be implemented on a state-wide scale.

The success of the pilot project enabled CRAM and MDOT to jointly develop a new asset management bill for the Michigan Legislature's consideration. This new bill, Act 499 of 2002, set up the frame work for a statewide asset management program and established the Transportation Asset Management Council (TAMC).

The following list provides a brief overview of the recent legislation affecting asset management in Michigan.

1998 Act 51 creates the Transportation Funding Study Committee. The committee is charged with studying transportation funding issues and making recommendations for improving the way public agencies operate and maintain their services.

2000 Legislation was introduced to implement many of the recommendations generated by the Act 51 Transportation Funding Study Committee. The legislature chose to not act on the proposed bill.

2002 Act 499 defined asset management in the State of Michigan and created the Transportation Asset Management Council (TAMC) under the supervision of the State Transportation Commission. This Act defined the roles and responsibilities of the COUNCIL and public agencies.

2006 Act 338 permits the transfer of funds between primary and local roads on the basis of an asset management plan.

2007 Act 199 amended the 1951 PA 51. The act requires the Council, in conjunction with the department, counties and municipalities, to develop a pavement management system for each mile of federal aid eligible highways in the state. Among other requirements of the council, the act requires each county to submit data to the council on an annual basis.

B. Transportation Asset Management Council (TAMC)

The Council was formed under Public Act 499 of 2002 in order to aid local public agencies in the facilitation of asset management. Representatives from MDOT, CRAM, Michigan Municipal League (MML), Michigan Townships Association (MTA), Michigan Association of Counties (MAC), Michigan Association of Regions (MAR), and the Michigan Center for Geographic Information (MCGI) make up this diverse council.

The council's responsibilities include:

- Collecting condition data of federal-aid eligible roads and bridges;
- Collecting asset investment data;
- Reporting the collected data and analysis to the Legislature and State Transportation Commission; and,
- Providing training and education focusing on enhancing asset management throughout the state.

The Council is looking to change the perception of the asset management concept from a reactive to a proactive system. This change requires setting performance targets, managing investment priorities, and considering the entire roadway (slope, street furniture, curb and gutter, etc.), not just pavement condition. Additionally, the Council stresses and encourages cooperation between regional planning agencies and local road authorities in order to provide a superior road system.

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Our Goals

The council will support excellence in managing Michigan's transportation assets by:

1. Advising the Legislature and State Transportation Commission
2. Promoting Asset Management Principles
3. Providing Tools and Practices for Road Agencies

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Data Collection

The Council relies on member agencies to actively collect and submit their local condition data in order to accurately depict current conditions and predict future conditions. Non-condition data such as level of service, traffic flow, and safety data is still in its infancy stages with regards to data collection. As asset management becomes more widely adopted, this type of data will become essential in the development of candidate projects and safety and traffic improvement needs.

PASER (Pavement Surface Evaluation Rating) is a method used for collecting and reporting pavement condition data. This method consists of visually inspecting the roadway surface in a vehicle containing one representative each from MDOT, the Metropolitan Planning Organization (MPO), or Regional Planning Organization (RPO), and local City/Village or County. The PASER rating system follows a scale from 1-Failed (e.g., pavement that has failed) to 10-New (e.g., pavement that is new) and is based on the types and severities of distresses visible in the pavement. Due to the subjectivity of this evaluation, representatives from multiple agencies are required which in turn builds collaboration between agencies and can be noted as a positive aspect.

A similar method is used when evaluating bridges. The National Bridge Inventory Rating Scale, from 0 to 9 indicates the current conditions of a bridge structure. Bridge inspectors assess the deck, superstructure, and substructure of a bridge as individual elements. Bridges that are over 20 feet long are inspected every two years and the results are stored in the MDOT's National Bridge Inventory (NBI) database.

The Council requires complete data collection and submission every two years. Worksheets for Road Data collection are available through the Council and Bridge Data collection are available through the MDOT.

Education and Training

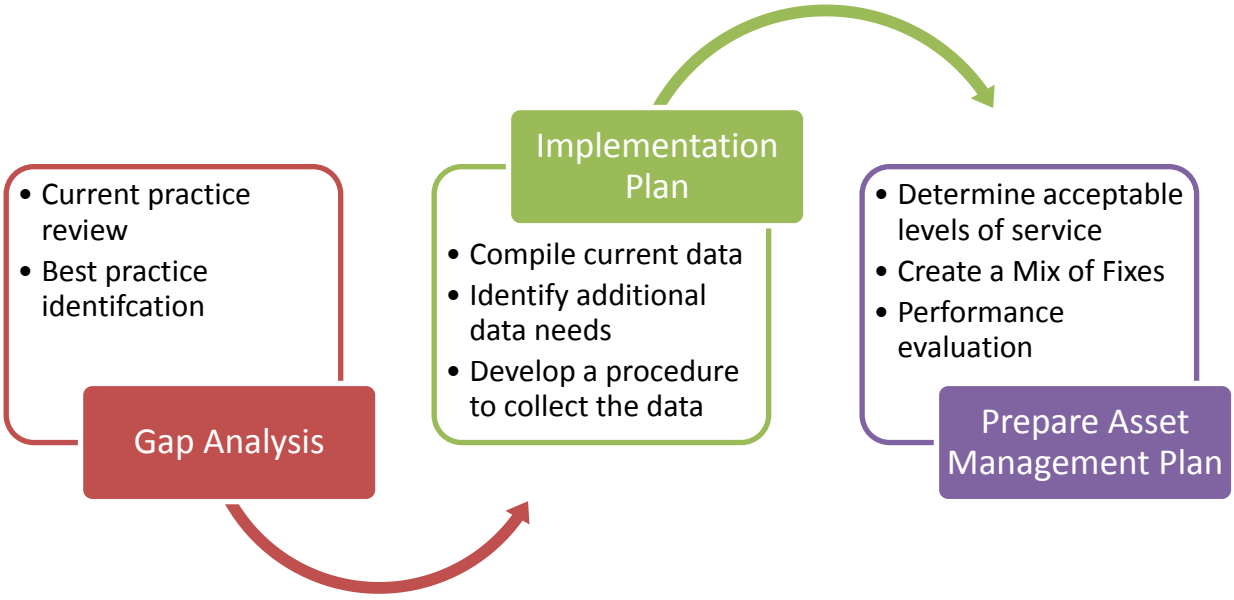
The Council coordinates education and training through the Michigan Local Technical Assistance Program (LTAP), along with member RPO/MPO'S throughout the State. Courses offered are generally focused on Pavement Management and Preservation. An Advanced Asset Management course provides an overview of asset management principles and how they may be applied in the context of resource allocation process that can be used by local governments.

Strategic Analysis

A goal of the Council is to create a strategic analysis approach to asset management implementation. This includes a shift from reacting to immediate problems "Worst First" to looking at the long view of how the system functions in a holistic manner "Strategic". This will allow the user to more easily predict future system conditions and then measure these conditions against various funding scenarios in order to come up with a targeted strategic plan.

C. Implementing Asset Management

Asset management should not be an entirely new process to any agency. Every public agency has some knowledge of their assets, such as road miles, bridges, etc. under their jurisdiction. Implementing an asset management decision process is nothing more than developing a method to compliment the agency's current practices. The following flow chart is an example of a macro process used to implement asset management.



The flow chart demonstrates that asset management is not entirely new and that each public agency may have already been practicing elements of the required processes. Implementation of these elements must therefore result in a method, which is consistent with the agency's current practice.
Asset management is a process that enables the people who manage the asset to do so in a more informed manner. Because of this process, a structured approach may be required to change established practices and mindsets. Implementation plans need to address issues that include:

Processes	Existing and desired procedures
Data & Systems	Collection, storage, management, and analysis of asset related data
People	Organization, cultural change, and resistance

D. RoadSoft

RoadSoft was developed by the Center for Technology & Training, at Michigan Technological University. The software is a roadway asset management system that is available to all public road agencies within the State of Michigan. This powerful tool has modules for:

- Strategy Evaluation
- Pavement Deterioration
- Culvert Inventory
- Guardrail Inventory
- Road Inventory
- Sign Inventory
- Sign Retroreflectivity
- Pavement Markings
- and other assets

RoadSoft is fully endorsed by the Council as the preferred software package for use by road agencies and can be utilized to complete many of the tasks indicated in the following section. RoadSoft also works directly with the Council's online Investment Reporting Tool (IRT).

Throughout the remainder of this document the sections with tasks accomplishable through RoadSoft are noted with the RoadSoft logo.

III. Glossary of Terms and Abbreviations

The following sections help to establish a consistent foundation for terminology used to discuss the management of assets. Some of the terms presented below will be different from those you or your agency may be familiar with using to discuss pavement assets. The change has been made to keep terminology consistent across all assets, such as pavements, bridges, and signs, and to allow for the same procedures to be easily applied to any asset group.

A. Definitions of Terms

Current Replacement Cost: The amount of today's dollars required to replace an existing asset.

Current Residual Vale: The remaining value of an asset after it has been fully depreciated.

Flexible Pavement: A pavement that yields "elastically" to traffic loading. Its strength is derived from the load-distributing characteristics of a layered system designed to ultimately protect each underlying layer including the subgrade from compressive shear failure; asphalt pavements fall into this category.

Operations Activity: Work items that facilitate the use of the infrastructure; e.g. snow plowing or culvert cleaning. These items are one-time expenditures with no residual value.

Maintenance Activity: Work items that repair the infrastructure; e.g. crack sealing, patching, and straightening a bent sign post. These items are one-time, or recurring, expenditures with low residual value.

New Assets: Work items that create new infrastructure or add to existing infrastructure; e.g. building a new road, adding a turn lane, up-sizing a culvert.

Renewals Activity: Work items that replace the infrastructure; e.g. mill and fill, culvert replacement, and pedestrian push button replacement. These items are one-time costs with high residual value.

Rigid Pavement: Any pavement substantially constructed of high strength concrete.

B. List of Abbreviations

CIP: Capital Improvement Plan

MOP: Metropolitan Planning Organization

MTF: Michigan Transportation fund

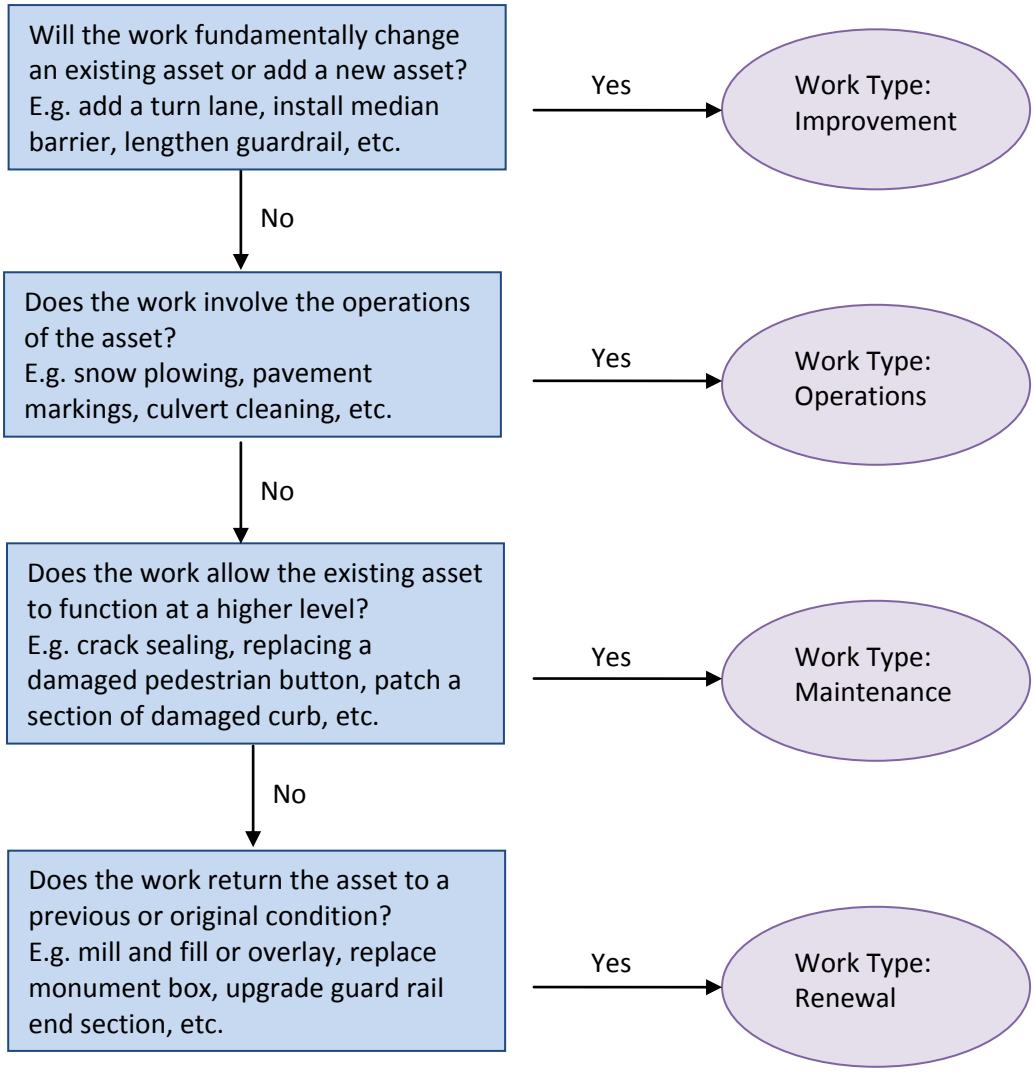
PASER: Pavement Surface Evaluation and Rating

RSL: Remaining Service Life

TAMC: The Transportation Asset Management Council

C. Activity Type Decision Process

The following figure will assist you in determining what type of work activity you are engaging in.

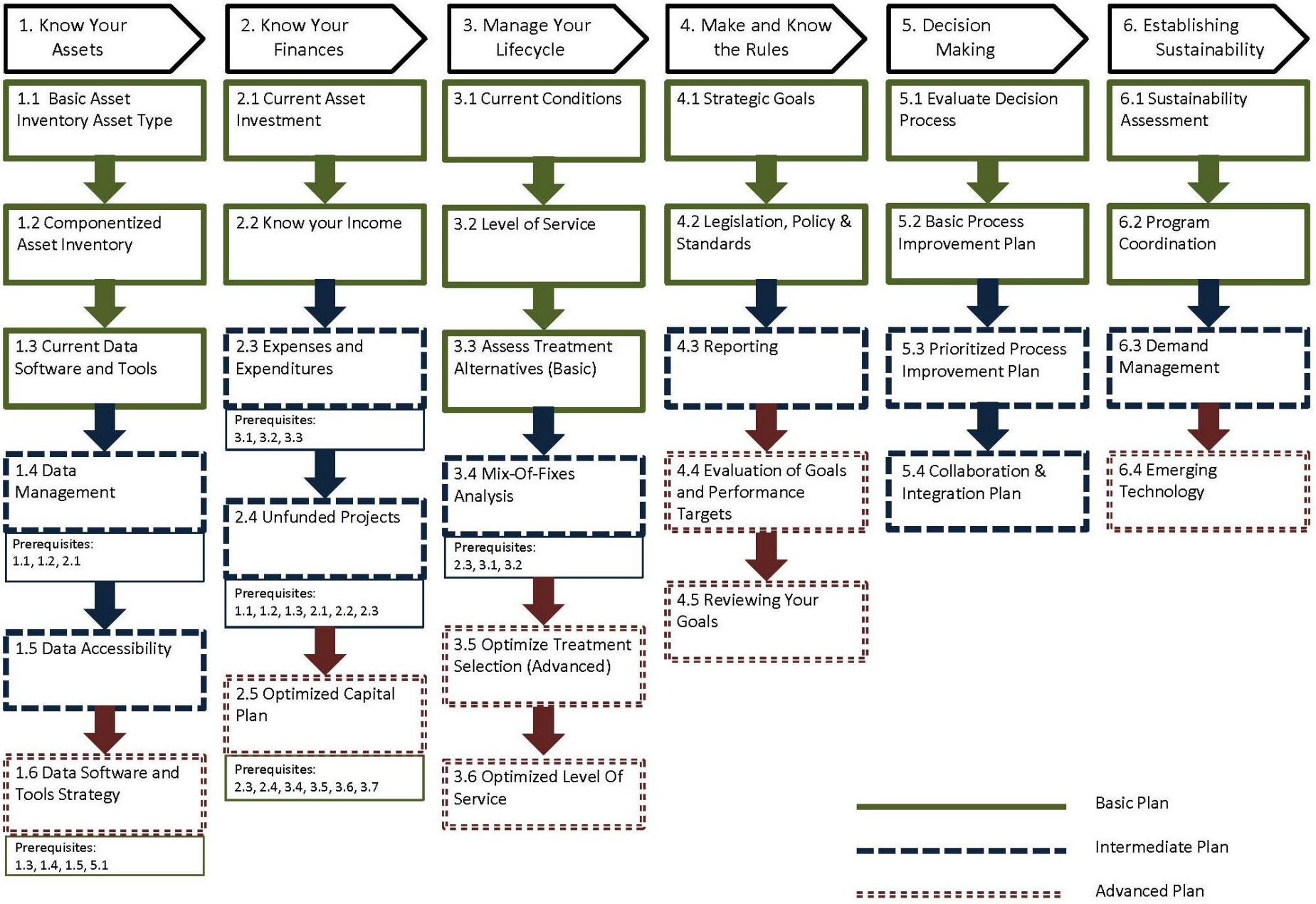


Part B: Developing an Asset Management Process and Plan

Detailed Guidance on Developing Your Agency's Process and Plan

Now that you have a refined understanding of the asset management concept, you are ready to begin developing your own asset management process and documenting that process in a plan. Part B of this document provides a step-by-step guide to establishing that process.

The flowchart on the following page provides an overview of the process. Each box represents a step and directly corresponds to a section in the following text.


1. Know Your Assets
1.1 Basic Asset Inventory Asset Type
1.2 Componentized Asset Inventory
1.3 Current Data Software and Tools
1.4 Data Management
Prerequisites: 1.1, 1.2, 2.1
1.5 Data Accessibility
1.6 Data Software and Tools Strategy
Prerequisites: 1.3, 1.4, 1.5, 5.1
2. Know Your Finances
2.1 Current Asset Investment
2.2 Know your Income
2.3 Expenses and Expenditures
Prerequisites: 3.1, 3.2, 3.3
2.4 Unfunded Projects
Prerequisites: 1.1, 1.2, 1.3, 2.1, 2.2, 2.3
2.5 Optimized Capital Plan
Prerequisites: 2.3, 2.4, 3.4, 3.5, 3.6, 3.7
3. Manage Your Lifecycle
3.1 Current Conditions
3.2 Level of Service
3.3 Assess Treatment Alternatives (Basic)
3.4 Mix-Of-Fixes Analysis
Prerequisites: 2.3, 3.1, 3.2
3.5 Optimize Treatment Selection (Advanced)
3.6 Optimized Level Of Service
4. Make and Know the Rules
4.1 Strategic Goals
4.2 Legislation, Policy & Standards
4.3 Reporting
4.4 Evaluation of Goals and Performance Targets
4.5 Reviewing Your Goals
5. Decision Making
5.1 Evaluate Decision Process
5.2 Basic Process Improvement Plan
5.3 Prioritized Process Improvement Plan
5.4 Collaboration & Integration Plan
6. Establishing Sustainability
6.1 Sustainability Assessment
6.2 Program Coordination
6.3 Demand Management
6.4 Emerging Technology
Basic Plan
Intermediate Plan
Advanced Plan

1 Know Your Assets

The first step in developing an Asset Management Plan is to know those assets possessed by your agency. An asset can be defined in two ways: assets may be tangible or intangible. A tangible asset may be a post mounted stop sign at an intersection while an intangible asset may be the computer programs used by your agency to perform specific tasks. For the purposes of this asset management plan we will only consider tangible assets.

1.1 Basic Asset Inventory

An asset inventory, documenting any information that is available for each asset, is the simplest way to systematically and logically begin to know your assets. Types of information that are useful in an asset management plan are type, quantity, material, useful life, installation date or age, remaining life, and location.

When you begin assembly of your asset inventory, consider asking yourself the following questions:

- How would I classify the type of asset? Is it a section of pavement, whole bridge, or a retroreflective sign?
- How many are there and what size are they?
- What are these assets made of? E.g. is the pavement flexible or rigid?
- What is the predicted useful life of the asset? How long is it expected to last?
- When was this asset installed? How old is the asset with respect to its total service life?
- What is the remaining life of the asset? How much longer will the asset be useful to the agency before it needs to be replaced?
- Where is this asset located? Do I know the approximate or exact location of this specific asset?

Table 1-1, below, illustrates a way to summarize pavement data.

	Roadway Classification (lane miles)			
Material	**Type 1**	**Type 2**	**Type 3**	**Type 4**
Gravel	80	350	200	1160
Concrete	1290	2950	0	500
HMA	2350	4590	2100	1040

Table 1-1 Summary of Pavement Data

1.2 Componentized Asset Inventory

Beyond your basic inventory, it will be helpful to break some items into smaller, more manageable, sub-groups or components. Consider the following examples.

Sign Example

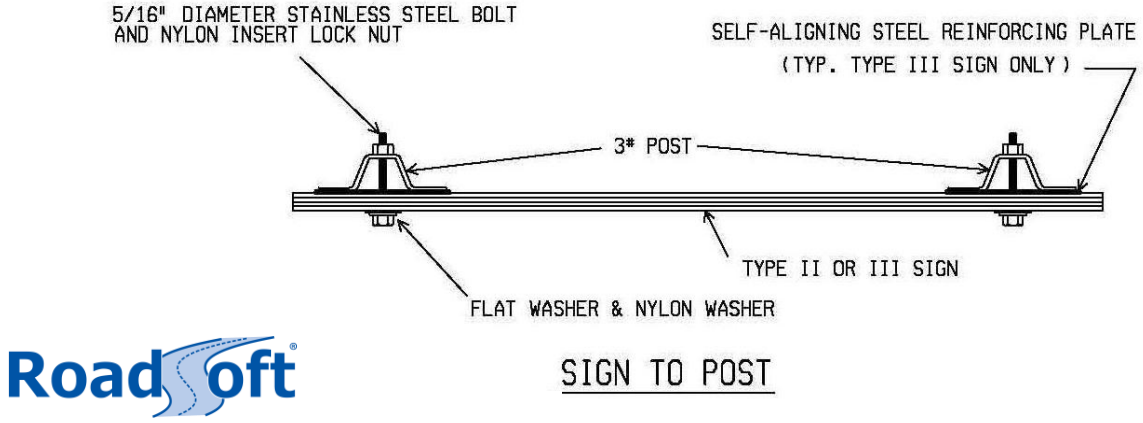


Figure 1-1 Componentized Sign Assembly

In this figure we see a sign mounted to a decorative pole that is made up of three main components, the post, the sign, and the hardware. It may be helpful to think of your asset in terms of what components can be replaced singly. Each of these components has different inventory information associated with it. The materials, size, and predicted useful life may all be different though the location may be the same.

In fact, it is not out of the question to recognize that the installation dates may not be the same. The actual sign may need to be replaced multiple times before the post and mounting bracket needs to be replaced. Due to the nature of the hardware used on signs, it will be replaced when the sign is replaced.

Table 1-2 Componentized Sign Asset Data

	Type	Quantity	Material	Useful Life (yrs)	Installation Date	Remaining Life (yrs)	Location (Lat/Long)
Sign	Sign	1	Type IV Reflective Sheeting	7	1/24/2008	4	42.489097/ -83.135736
Post	Sign	1	Steel	15	2/26/2005	12	42.489097/ -83.135737
Nuts	Sign	2	Steel	7	2/26/2005	4	42.489097/ -83.135738
Bolts	Sign	2	Steel	7	2/26/2005	4	42.489097/ -83.135739

Table 1-2, above, illustrates what componentized STOP sign information may look like. Breaking an asset into smaller asset components can be very useful when determining a replacement schedule.

Flexible Pavement Example

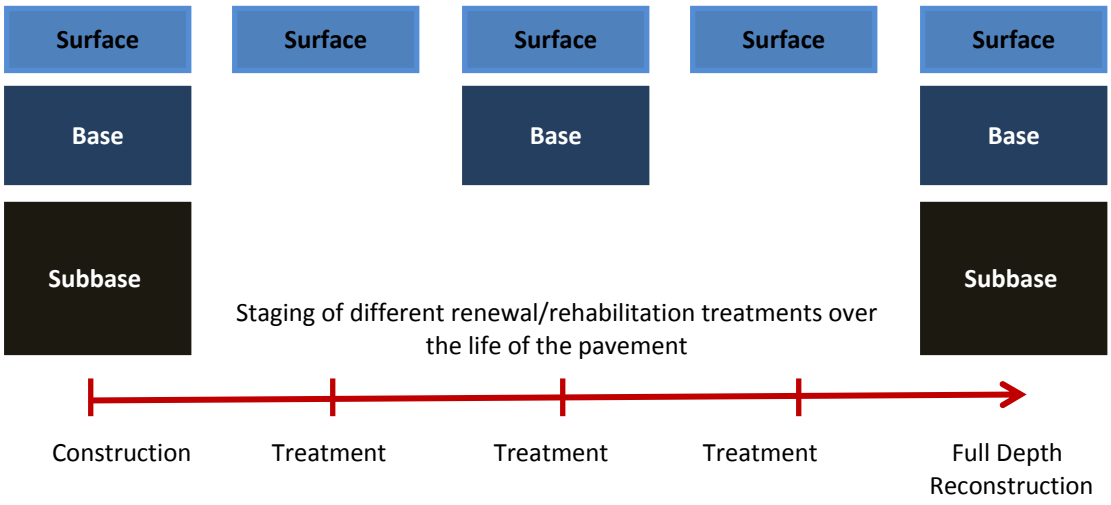


Figure 1-2 Pictorial Pavement Treatment Schedule

The surface of a flexible pavement is typically replaced at least once—sometimes many times—before it is necessary to also replace the underlying base layer, and both the surface and base pavement layers may be rehabilitated or renewed at least once before it is necessary to do a full depth rehabilitation that includes re-constructing the subbase layer. Thus the road pavement should be recorded as 3 distinctly separate layers with different expected life spans.

1.3 Current Data Software and Tools

Once you have a basic understanding of your asset sizes and quantities, it is important to begin considering how that data will be stored and managed. Data Software and tools are available to simplify and streamline the management of your data and will ultimately simply your decision making processes. RoadSoft, available to all Michigan road agencies, is the Council's preferred software for data storage and asset management tasks.

RoadSoft, developed by Michigan Tech, contains geographically coded data on all public roads in Michigan. This software package allows you to easily manage pavement assets as well as sign, culvert, and guardrail assets. However, in order to fully utilize any software package, some additional information about your assets is necessary.

If records of expenses are available electronically, they can be useful in creating a more robust asset management plan. Some examples of information that are useful with respect to expenditures are the capital cost (or initial cost of an asset), the date the asset was purchased, the depreciation rate, and the current market value.

Work or maintenance performed, as well as the potential to do additional work, are assets. Although work, and/or maintenance are assets that can be accounted for, these items may seem intangible.

Records of processes, work activities, and work histories associated with the installation, maintenance, and renewal of other tangible assets can be factored into the total cost of an asset.

1.4 Data Management

The completeness and accuracy of recorded information must be available to the people who will use that data to make decisions and perform lifecycle management for the assets and components. Knowing whether a piece of information is a 'best guess' or a 'measured fact' will affect decision-making. Additionally, processes and controls need to be put in place to ensure that the data is appropriately secure and is maintained and updated as required.

Once you've collected and organized all of the data available on your assets, it is important to consider not only the accuracy but also the completeness of your database and if there are any gaps in the information.

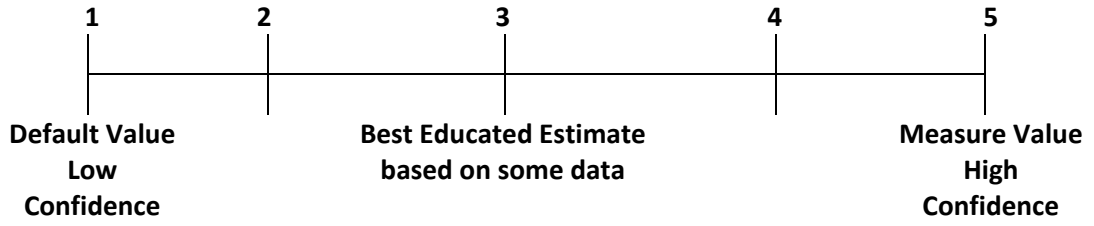
Data Completeness & Accuracy

Educated guesses and estimates are necessary as you begin data collection. You may have had to rely on old or outdated information to fill in some of the gaps in your asset management plan. It is unreasonable to expect that an agency would go and tear up a road to manually measure the depth of the base-course. Complete data with some inaccuracy is often more useful than no data at all.

Consider the accuracy of the data on your assets and your confidence in those data. In some cases, it may have been necessary to record the best estimate of an asset attribute. Noting this accuracy within the data set is helpful for creating the most robust treatment plans. Adjustments and corrections can be made in calculations and plans if the approximate accuracy of the information is available. For example, as mentioned above, it may not be feasible to tear up a roadway just to measure the pavement thickness, but a new utility crossing may present an opportunity to supplement your asset information without unduly affecting the road.

Setting up a ranking system or scale to indicate the accuracy of data elements may be helpful. For example, a scale from 1 to 5 such that 1 indicates a default value or a best guess, low confidence in the accuracy the data, and 5 is a measured value, high confidence in the data..

Figure 1-3 Confidence Scale



If the data is recent and was measured in the field, a confidence ranking of 5 may appropriate. If you have some data available from some outdated plans found in storage, you may consider a ranking of between 2 and 4. These notations may help others in future project planning and decision making.

Data Gaps

It is important to acknowledge that gaps can occur in a data set and strive to reduce or prevent those gaps. Gaps in data come from many sources. Consider the following examples of data gaps and suggestions for how to resolve problems such as these.

Example Gap Type 1: The Need for Standards

The information within a data set is not typically collected by a single individual. Entry of data from many sources, without the structure of data collection standards, can result in duplication of effort, errors, or unusable information.

Collected By	Pavement Type	Location	Paser Rating	Date of Record
Technician A	Concrete	CS No. 651908	8	Unknown
Technician B	HMA	42º 32' 49.00 N 83 º 21' 39.00 W	5	February 24, 2011
Technician C	Bit.	.3 Mi E. of Maple Rd.	6	24-Jan-11
Technician D	Concrete	MP 1.888	8	6/20/09

Figure 1-4 Example Pavement Data Input

The example above illustrates how different users, inputting information in different formats, may result in an increased risk of errors and reduces the functionality of the data set. In this example, Technician A and Technician D have input data for the same location, a month apart. Technician B and Technician C also visited the same location and recorded approximately the same information, though it may not be readily apparent. Having a standard format for data collection makes data more functional and more reliable.

Example Gap Type 2: Data Format

Older data may not be available in easily searchable formats. As time goes on, hard copies of asset data may deteriorate, electronic media formats may change, and electronic data storage devices may become obsolete.

Example Gap Type 3: Loss of Data

Flood and/or fires may destroy physical copies of data, digital files may become corrupt; and computers crash. A catastrophic loss of information may result at any time.

All of these possibilities should be considered when evaluating the completeness of the available asset data. The reason for the gap should influence the plans for addressing the gaps. When you find that there are gaps in your data, estimations and approximations are an appropriate means of filling these deficiencies.

1.5 Data Accessibility

The accessibility of your data may govern its perceived usefulness; as such, certain topics should be reviewed and documented as part of the plan and process. Consider the following important questions when deciding upon the accessibility of your data.

What is the format of the available data?

Data may be stored in a variety of ways, from paper hard-copies of plans and outputs, spreadsheets and electronic documents, or proprietary databases with limited (or non-existent) output capabilities. A thorough review should be performed as to the current formats used for archiving data, with thought given to inter-operability and future migration to other systems.

Does current data include geocoding?

Adding geographic location data to asset information is a useful tool, as it helps track assets in conjunction with their spatial position. This information can be useful in a variety of other applications, including asset tracking or in relation to crash data.

Who has access to the data?

Documenting which users have full viewing and editing ability—as opposed to those with only viewable (read-only) rights—to the data (or associated tools) is a useful step in determining the safety and veracity of data.

1.6 Data and Software Tools

A data and software tools strategy is a rational review of current data management and access controls, and the advantages and deficiencies of those procedures.

The efficiency and effectiveness of how assets are managed has a direct relationship with the quality of the data used to inform decision makers. If decision makers are not aware of incomplete or inaccurate data then poor decisions may be made. Quality decisions may be more effectively leveraged from a quality data management plan.

Developing a strategy for data and software tools requires inputs from other areas. Other sections of an asset management plan may include:

a) Current data and software tools (section 1.3),
b) Current data management (section 1.4),
c) Data accessibility (section 1.5), and
d) Evaluate decision processes (refer section 5.1).

Data management may be more effectively managed if an objective review is first performed of the tools available, as it may be easier to generate a plan for implementation and integration after reviewing

the available options. Current tools or procedures may be deemed insufficient, while other available platforms may offer a better opportunity for increased efficiency, a reduced chance of data corruption, eliminate unnecessary data duplication, or improve the ease of dissemination to stakeholders.

2 Know Your Financial Situation

Understanding your financial position is vital to the responsible and efficient management of your assets. More robust, defendable, decisions can be made in each of the lifecycle phases of your assets, when relevant financial information is known.

Once basic asset and financial information is known, it is possible to undertake some rudimentary long term financial forecasting. Long term financial plans can then be developed from predictions of future expenditure needs for operations, maintenance and capital works associated with the asset. These expense predictions can then be checked against revenue predictions, which will verify the affordability of continuing to maintain and operate the asset in accordance with current practice. The comparison can identify if there is funding available for upgrading or improving the asset or alternatively (and more commonly), that there may not be sufficient funding in the future. In this case, because the planning and predictions are being done today, strategies can be developed and appropriate decisions can be made now to change the situation so the activity becomes affordable over time, or a case is put to funding decision-makers to increase the revenue allocation.

2.1 Current Asset Investment

By definition, an asset has value. When there is no longer any value associated with an asset, the asset then becomes a liability. There are a number of ways to express the value possessed by an asset.

Nearly all assets have an initial cost, the capital cost. Capital costs are most commonly incurred in the purchase of a tangible asset such as land, a building, or machinery. An example of an intangible capital cost may be moving stipend paid to a new employee. While capital costs are a “one-time” expense, the payment of these costs may be spread out over time.

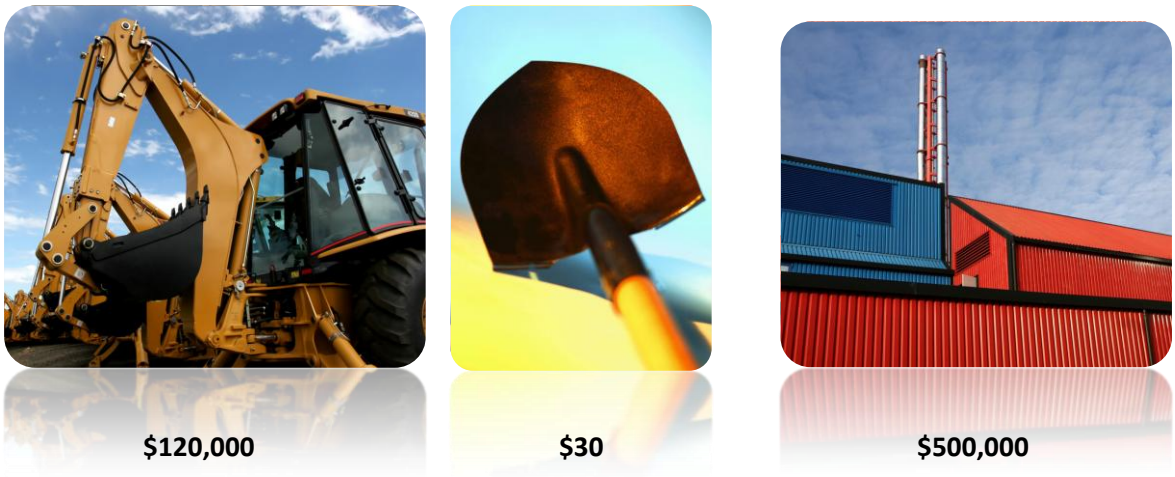


Figure 2-1 Example Capital Costs

Depreciation

Your agency already possesses any number of assets, each with an associated value. The value of any asset owned by any agency can never equal the capital cost. The moment a capital purchase is made the value of the asset begins to depreciate in value.

The depreciated value of an asset can be thought of as an asset's current value, in its current condition. All assets have differing rates of depreciation. Depreciation of an asset occurs as a result of physical depreciation, deterioration, or a change in demand for services.

The method of calculating an asset's depreciated value depends on the asset at hand. The simplest, most common way, of calculating the depreciated value of an asset is to use the "Straight-Line Method".

$$Annual\ Depreciation\ \ Expense = \frac{Capital\ Cost - Residual\ Value}{Useful\ Life\ (yrs)}$$

This method for calculating the depreciated value requires an estimate of the assets residual value, or current value.

Consider a bulldozer that has a capital cost of $120,000.00. If the bulldozer no longer runs, but had a life of 20 years, then its current worth is only in scrap value. We can calculate the annual depreciated expense:

$$\$5{,}250/year\ = \frac{\$120{,}000 - \$15{,}000}{20\ yrs}$$

The bulldozer is depreciating at a rate of $5,250/year, each year after the initial capital purchase was made.

Year	Value at the Beginning of the Year	Depreciation Expense	Value at the End of the Year	Accumulated Depreciation
1	$120,000 (capital cost)	$5,250	$114,750	$5,250
2	$114,750	$5,250	$109,500	$10,500
3	$109,500	$5,250	$104,250	$15,750
4	$104,250	$5,250	$99,000	$21,000
5	$99,000	$5,250	$93,750	$26,250

Table 2-1 Example Table of Depreciation Values

Consider also the "Declining-Balance Method", in which the rate of depreciation decreases gradually over time. This technique may be a more realistic approach to determining the depreciated value of an asset.

$$Annual\ Depreciation = Rate\ of\ Depreciation * Current\ Value\ (at\ the\ beginning\ of\ the\ year)$$

Again, let's look at the case of the bulldozer. For the sake of example we will assume a depreciation rate of 9.87%.

Year	Value at the Beginning of the Year	Rate of Depreciation	Depreciation Expense	Value at the End of the Year	Accumulated Depreciation
1	$120,000.00	9.87%	$11,844.00	$108,156.00	$11,844.00
2	108,156.00	9.87%	10,675.00	97,481.00	22,519.00
3	97,481.00	9.87%	9,621.37	87,859.63	32,140.37
4	87,859.63	9.87%	8,671.75	79,187.88	40,812.12
5	79,187.88	9.87%	7,815.84	71,372.04	48,627.96

Table 2-2 Declining-Balance Deprecation Example

As you can see above, while the rate of the depreciation remains the same, the Depreciation Expense (per year) decreases with time.

In the example of the Declining-Balance Method we assumed a depreciation rate of 9.87%. It is possible, and sometimes necessary, to calculate the Rate of Depreciation.

$$Rate\ of\ Depreciation = 1 - \sqrt[N]{\frac{Residual\ Value}{Cost\ of\ Fixed\ Asset}}$$

Such that the variable "N" is the estimated useful life (in years) of the asset.

So, as in our case of the bulldozer;

$$9.87\% = 1 - \sqrt[20]{\frac{\$15{,}000}{\$120{,}000}}$$

Current Replacement Costs

All assets also have associated replacement values or replacement costs. The term replacement value refers to the cost of replacing an asset at the present time. Both the replacement value and the depreciated value are important pieces of information when it comes to constructing an asset management plan. Part of your decision process should include determining the point where the cost of continued maintenance outweighs the value of the asset, as illustrated in Figure 2-2.

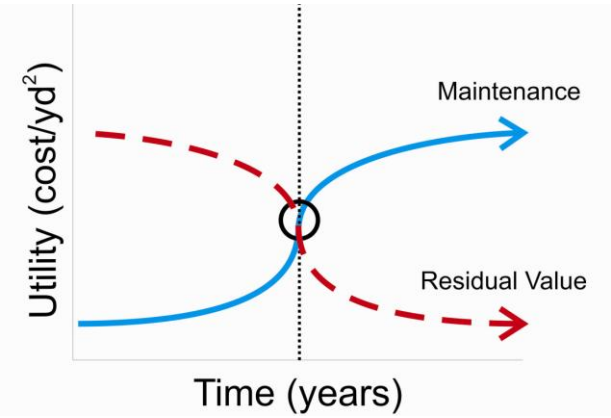


Figure 2-2 Utility Over Time

2.2 Know Your Income

Beyond the current state of assets belonging to an agency, a good asset management plan will allow for managing future assets. If you're a small local municipality, it's likely that you receive funding from your local government through taxes as well as from the State of Michigan and maybe even the federal government. A familiarity of those sources of income and an educated estimate as to the total income will be useful when you begin to plan future projects. Planned renewal projects such as a pavement overlay or replacement of all reflective signing in a certain area can be accounted for in an asset management plan.

In fact, an asset management plan can be one of the most valuable tools in planning for the future of an agency. Knowing the current assets and their expected useful life allows for advanced planning when it comes to the renewal or replacement of older assets.

Let's examine the example of a 20 mile stretch of rural highway belonging to a county road commission. The following data is available:

Beginning Mile Point	Ending Mile Point	Total Length (mi)	PASER Rating	Installation Date	Material
0.0	3.5	3.5	5	--	HMC
3.6	7.0	3.4	2	10/00	PCC
7.1	15.2	8.1	4	05/02	PCC
15.3	20.0	4.7	8	04/07	HMC

Table 2-3 Example PASER Rating Data

Given the coming year's budget and this above information, an agency can develop a plan for their "mix of fixes". The term "mix of fixes" refers to the combination of ways that an agency can address updating and maintaining their assets with the funds available.

The township in the above example may opt to address, first, that section of pavement with the lowest PASER rating and use any additional funds to address the section between 0.0 and 3.5. A good asset management plan will evaluate all of the combinations of "fixes" to determine which "mix" will produce the greatest return on investment. In other words, an asset management plan will address which

segments will get fixed, to what extent, and by how much the overall health of the network will increase.

2.3 Expenses and Expenditures

Where has all the money gone? The plight of all agencies, spending money is easier than making it. Truth be told, spending money is far too easy. Tracking those expenses and expenditures over time is a key component in making the most of your budget. When you track your expenses over time, a thorough analysis can be conducted to determine if you're making the most of your budget.

There are those expenses that are recurring and those expenses that are discrete and occur randomly. Labor and operational costs are recurring costs. Each year your agency has an educated estimation as to the total labor and operational expenditures. Capital costs such as new equipment, are slightly more discrete, but may follow a regular updating schedule.

Year	Annual Budget	Utilities	Labor	Equipment and Related Expenses	Maintenance and Regular Operations (approximately)
2006	$24,000,000	$130,000	$196,000	$500,000	$23,000,000
2007	$26,500,000	$130,000	$200,508	$500,000	$25,500,00
2008	$24,700,000	$142,000	$205,118	$500,000	$23,800,000
2009	$20,800,000	$131,500	$152,792	$3,000,000	$17,500,000
2010	$21,000,500	$129,500	$152,792	$500,000	$20,200,000

Table 2-4 Example Historical Annual Expense Data

Calculation of the average annual budget, the sum of the annual budgets over 5 years, divided by 5 years, is shown in the equation below:

$$Average\ Annual\ Budget = \frac{2006\ Budget + 2007\ Budget + \$2008\ Budget + 2009\ Budget + 2010\ Budget}{5\ Years\ (2006, 2007, 2008, 2009, and\ 2010)}$$

$$\$23{,}400{,}100 = \frac{\$24{,}000{,}000 + \$26{,}500{,}000 + \$24{,}700{,}000 + \$20{,}800{,}000 + \$21{,}000{,}500}{5\ Years}$$

Examining the information from the above example, we see that this agency's average annual budget is $23,400,100. The year 2007 had an influx of grant money and there were steep budget cuts in 2009. On average, they can count on around $23,000,000 annually. The year 2008 brought colder than normal temperatures and the utility bill increased. The average utility bill costs $132,600. In 2007, this agency has one senior transportation engineer, one junior transportation engineer, and one technician on staff. Labor costs increase yearly at a nearly steady rate given yearly cost-of-living increases. As a result of the budget cuts in 2009, the agency laid off their junior engineer. A budget is in place to allocated $500,000 to equipment maintenance. In the year 2009, a tornado destroyed ½ of their total paving equipment and machinery. The resulting total of the annual budget less the utilities, labor, and equipment is allocated to projects.

Given information such as this, an agency can better plan for the future. Additional years of data will make the cost approximation more reliable and more robust.

2.4 Unfunded Projects

Unfunded Projects are items of work that an agency had identified as being necessary maintenance, renewal, or improvement projects without having the funds to pay for those projects. Unfunded projects are a liability to an agency, who realizes a real cost from doing nothing. This real cost for an agency is realized through continued deterioration of the asset as well as through the continued increase is labor and materials costs.

Identifying unfunded projects is important when projecting future income needs and communicating those needs with elected officials and the public. Identifying these projects is also critical when reviewing your mix-of-fixes and developing an optimized capital plan.

2.5 Optimized Capital Plan

An optimized capital plan is a physical works program that has been reviewed and modified to reflect optimal cost/benefit project options. The most cost effective—not necessarily the lowest cost—option for each project in the program may take into consideration any of the following:

- Asset replacement projects should compare a modern equivalent material or type
- Review of whether capacity requirements may be reduced. At times a surplus capacity may be included in assets to manage peak events. This can trap an agency into committing to a large cost for a seldom-used portion of an asset. Other options may be available to provide the necessary level of service during peak events or a cost/benefit analysis may determine that a lower level of service should be accepted during peak events to save costs.
- Identify opportunities to reduce costs by coordinating similar projects in close proximity or bidding/bundling projects together for a construction cost savings due to the subsequent increased project size.
- Consider cost-effective alternative treatments and emerging technologies that may achieve an equivalent or improved end result as compared to conventional treatments.
- Review the lifecycle costs to ensure that the optimal treatment or construction options have been selected. For example, if option A costs $1M—with a 50 year expected lifespan and lifetime maintenance costs estimated at $350,000—then the lifecycle cost will be $1.35M or $27,000 per annum. Option B may cost $1.2M—but with a 60 year expected life and $150,000 lifetime maintenance costs—resulting in a lifecycle cost also of $1.35M. However, with an expected life of 60 years, the per annum average is only $22,500—making it a better long term choice despite its higher initial construction cost.

3 Managing Your Asset Lifecycle

The purpose of actively managing the lifecycle of your assets is to maximize the 'Lifecycle Benefits' that you can get from those physical assets. The aim, therefore, for most situations, is to get the optimal performance and longest lifespan from each asset at the lowest total cost over its entire life. To achieve this aim it may be necessary in some cases to pay higher installation costs for a better quality asset so that the longer term maintenance costs are reduced. Similarly, selection of a particular treatment or intervention at an optimal time in the life of the asset is also likely to reduce the total life cost of the asset by extending its life, reducing maintenance costs or both of these.

To effectively manage the lifecycle of your assets you must have a good understanding of your assets, your goals and your limitations.

3.1 Current Conditions

The condition of an asset component is a measure of its physical state compared to a brand new component. Condition information is an important input to lifecycle management and planning. Tracking the change in condition over time will provide an indicator for rate of deterioration and support more accurate estimates for remaining useful life and prediction of failure. This information can then be used to better determine optimal intervention treatments and future budget requirements to get the maximum service life out of your assets. Consider asking yourself the following questions when evaluating the condition of an asset:

Is the condition of the asset known?

Having current condition information about the separable asset components in your inventory and, desirably, some past condition data so that the rate of deterioration over time can be assessed and predictions of when it will need repair or replacement can become more accurate over time.

Is the condition represented as a comparable rating score or as a description only?

In reality, any condition data is better than none. However condition assessments completed in accordance with a recognized standard, and derived from a measurement are more reliable and robust than ones derived from observation. Where measured data is not available, assessments from observations using a prescribed rating system are better than those based only on opinion or an arbitrary rating system.

How much longer do you expect this component to last?

This information can be calculated from knowing the typical or average expected lifespan of the component and its current age. However, this will only produce a typical theoretical estimate, which is an acceptable starting point only when there is no other information available. As more information is gathered about the asset, particularly condition and performance data, a more accurate remaining life can be estimated for each component, based on its actual in-service situation. This will improve the quality and accuracy of lifecycle planning and budget predictions over time.

3.2 Level of Service

Within the constraints of asset management, the level of service (LOS) is often defined as the service quality for a given activity. Levels of Service are often documented as a commitment to carry out a given action or actions within a specified time frame in response to an event or asset condition data.

The International Infrastructure Management Manual defines "Level of Service" as "the defined service quality for a particular activity (i.e. travel) or service area (i.e. street lighting) against which service performance may be measured. Service levels usually relate to quality, quantity, reliability, responsiveness, environmental acceptability and cost." [1]

Defining service levels are critical to establishing a fully functioning asset management plan. An example of a way to organize your data can be seen below.

Asset	Reported Problem	Evaluation Parameter	Remedy	Measure
Item Description	Issue Description	Rating (Condition/Severity/Frequency)	Replace/Repair/Treat	Response Time

What types of assets make up your building and what types of related maintenance issues occur?

Asset	Reported Problem	Condition (0=Worst Condition; 10= New Condition)	Remedy	Measure
Window	Cracked	5	Replace	7 days
Wallpaper	Torn	7	Repair	1 month
Ceiling Tiles	Water Damage	3	Replace	6 months
Grounds	Flood	1	Drainage Upgrade	3 months

Table 3-1 Example Maintenance Schedule Goals

How do you quantify the quality of the service rendered?

A basic rating system, devised by your local agency can indicate the level of service. Consider basing your level of service rating on the time it took to respond to the issue such that a rating of 'A' means that immediate action was taken to perform the described remedy whereas a rating of 'F' may indicate a failure to address the problem before more extensive problems occurred.

3.3 Assess Treatment Alternatives

Assessment and evaluation of your chosen remedies will provide you with a means to improve your level of service. To begin this assessment, consider these questions:

- How does your agency determine what type of treatment should be applied?
- What are your standards for determining which treatments are implemented and when?

[1] http://www.lgam.info/level-of-service

- What are your different treatment options?

Different treatments will extend the service life of your asset by varying amounts, at the tradeoff of a great disparity in unit costs. Asphalt treatments could include:

- Total reconstruction
- Rehabilitation with extensive base repairs
- Patching with major overlay
- Structural overlay of two inches or more
- Non-structural overlay less than two inches
- Sealcoating
- Routine crack filling

Routine crack filling may cost only a fraction of a structural overlay, but will have to be repeated at a much greater frequency for the same equivalent extension of service life.

Similarly, concrete treatments could include:

- Joint and crack re-sealing
- Retrofitting concrete shoulders to decrease edge stresses
- Slab stabilization
- Full- and partial-depth repairs
- Concrete pavement restoration including diamond grinding
- Concrete overlays
- Full depth paving & reconstruction
- Reconstruction with Fast Track paving

Two concrete overlay technologies that have entered increased use are whitetopping and ultra-thin whitetopping.

Conventional whitetopping consists of a thick concrete layer (greater than 4 inches) on top of an existing asphalt pavement. The performance is similar to a new concrete pavement placed on a strong base.

Ultra-thin whitetopping is a two- to four-inch layer placed on the prepared surface of an existing asphalt pavement. This layer is bonded (or partially bonded) to the underlying asphalt surface, and features significantly reduced joint spacing (2 to 6 feet as opposed to a conventional spacing of 12 to 16 feet).

3.4 Mix-of-Fixes Analysis

A “Mix-of-Fixes” analysis is one of the easiest ways to begin to optimize the use of your assets. The term Mix-of-Fixes to refers to all the potential combinations of allocated asset resources.

Let’s begin with a pavement example.

It's the beginning of the year and your agency has 12 million dollars to maintain 150 lane-miles of roadway. Of those 150 miles, 72 miles are rigid pavement and 78 miles are flexible pavement.

There are different costs and design lives associated with different "fixes".

	Pavement Types					
	Rigid		*Flexible*			
Type of Rehabilitation	Full Reconstruction	Rubblize & Resurface	Full Reconstruction	6" Overlay	3" Overlay	2" Overlay
Cost/Lane Mile ($1,000)	950	600	750	150	85	70
Design Life	28	16	18	13	8	4

Table 3-2 Example Initial Pavement Data

A twenty mile segment of rigid pavement being rubblized and resurfaced will cost $12,000,000. Of your yearly budget of $12,000,000, you've used 100% of your total budget to address 13% of your total network.

Your total network, in terms of pavement condition, may be represented like this:

	Number of Lane Miles in the designated RSL Category							
	0-2	3-5	6-10	11-15	16-20	21-25	26-30	Totals
Rigid	64	7	1	0	0	0	0	72
Flexible	27	19	27	5	0	0	0	78
Totals	91	26	28	5	0	0	0	150

Table 3-3 Example Lane Miles by Relative Service Life

In this instance, the RSL of the pavement is the "remaining service life" or the number of years of remaining serviceability of the asset. The pavement in the 0-2 range has either already failed or has up to two years before total failure to service its user. The majority of your network, roughly 61%, is in the 0-2 range.

Does it make the most sense to allocate the entirety of your $24 million dollar budget to the 91 miles of pavement with the lowest service life rating? If not, then to what extent should this pavement be fixed?

The method of addressing only those assets in dire straits is often referred to as the "Worst First" method of maintenance.

You can address a maximum of 12 of the 64 total miles of the rigid pavement in the 0-2 RSL category if you opt for a full reconstruction.

12 miles x $950,000/mile = $11,400,000

A full reconstruction project over 12 miles would increase the number of miles in your 26-30 RSL category by 12.

	Number of Lane Miles in the designated RSL Category							
	0-2	3-5	6-10	11-15	16-20	21-25	26-30	Totals
Rigid	52	7	1	0	0	0	12	72
Flexible	27	19	27	5	0	0	0	78
Totals	79	26	28	5	0	0	12	150

Table 3-4 Example of Rigid Pavement RSL Improvements Utilizing the Worst First Method

You can address a maximum of 16 of the miles of the flexible pavement in the 0-2 RSL category if you opt for a full reconstruction.

16 miles x $750,000/mile = $12,000,000

A full reconstruction project over 16 miles would increase the number of miles in your 26-30 RSL category by 16.

	Number of Lane Miles in the designated RSL Category							
	0-2	3-5	6-10	11-15	16-20	21-25	26-30	Totals
Rigid	64	7	1	0	0	0	0	72
Flexible	11	19	27	5	0	0	16	78
Totals	75	26	28	5	0	0	16	150

Table 3-5 Example of Flexible Pavement RSL Improvements Utilizing the Worst First Method

In the interim, the other 134-138 remaining miles of pavement continue to age and decrease in their years of remaining service life.

Ultimately, using the worst first method will result in your pavement network failing catastrophically at an exponential rate.

An optimized mix-of-fixes strategy will make the most of your budget.

	Pavement Type					
	Rigid		*Flexible*			
Type of Rehabilitation	Full Reconstruction	Rubblize & Resurface	Full Reconstruction	6” Overlay	3” Overlay	2” Overlay
Cost/Lane Mile ($1,000)	950	600	750	150	85	70
Design Life	28	11	18	13	8	4
Year	Number of Lane-Miles for Type of Rehabilitation					
2011	3	6	4	7	8	8

Table 3-6 Example of Optimized Pavement Management Plan

The cost of rigid pavement maintenance:

3 Mile Full Reconstruct x $950,000/Mile
+ 6 Miles Rubblize & Resurface x $600,000/Mile
$6,450,000

The cost of flexible pavement maintenance:

4 Mile Full Reconstruct x $750,000/Mile
+ 7 Miles 6" Overlay x $150,000/Mile
+ 8 Miles 3" Overlay x $85,000/Mile
+ 8 Miles 2" Overlay x $70,000/Mile
$5,290,000

Rigid Pavement Maintenance + Flexible Pavement Maintenance

$6,450,000 +$5,290,000= $11,740,000

Given this "mix-of-fixes" optimization analysis, we can see that 36 total miles of pavement have increased their relative service life.

It is important to keep in mind that the RSL of the pavement is constantly changing. For the sake of this example, we will assume that that pavement which is not being addressed remains at its present RSL in order to show the improvements being made.

If we apply 3 miles of reconstruction to those miles in RSL category 0-2, 5 miles of rubblizing and resurfacing to those miles in RSL category 3-5, and 1 mile of rubblizing and resurfacing to those miles in RSL category 6-10, our improvements may look like the following table:

	Number of Lane Miles in the designated RSL Category							
	0-2	3-5	6-10	11-15	16-20	21-25	26-30	Totals
Rigid	61	2	0	0	5	1	3	72
Flexible	27	19	27	5	0	0	0	78
Totals	88	21	27	5	5	1	3	150

Table 3-7 Example of Rigid Pavement RSL Improvements Utilizing and Optimized Plan

If we apply 4 miles of reconstruction to those miles in RSL category 0-2, 7 miles of 6" overlay to the 3-5 RSL category, 8 miles of 3" overlay, and 8 miles of 2" overlay to those miles in the 6-10 RSL category, our improvements may look like the following table:

	Number of Lane Miles in the designated RSL Category							
	0-2	3-5	6-10	11-15	16-20	21-25	26-30	Totals
Rigid	64	7	1	0	0	0	0	72
Flexible	23	12	11	13	7 8	4	0	78
Totals	87	19	12	13	15	4	0	150

Table 3-8 Example of Flexible Pavement RSL Improvements Utilizing and Optimized Plan

The total combined improvement may look like the table below:

	Number of Lane Miles in the designated RSL Category							
	0-2	3-5	6-10	11-15	16-20	21-25	26-30	Totals
Rigid	61	2	0	0	5	1	3	72
Flexible	23	12	11	13	7 8	4	0	78
Totals	84	14	11	13	20	5	3	150

Table 3-9 Combined Rigid and Flexible Pavement RSL Improvements Utilizing and Optimized Plan

The mix-of-fixes method increases the overall health of the network.

This is a very over simplified example of asset optimization. Optimization is most easily performed by using the RoadSoft Software provided through Michigan's LTAP.

Other variables such as time, labor costs, the rate of degradation, and inflation should all be taken into account when optimizing an asset management plan.

3.5 Optimized Treatment Selection (Advanced)

A more advanced level of optimized treatment selection may require dedicated specialty software or a customized database. This optimization may be completed in-house or contracted out to firms specializing in this area. Detailed, accurate asset data would be required to achieve meaningful results, therefore it is not recommended that a sophisticated level of treatment selection analysis be undertaken until essential key attributes are known to a reasonable degree of accuracy. The key attributes are those affecting the calculation of expected life, remaining life and cost. These could include:

- Size (length, width, depth or other dimension as relevant to the asset type)
- Material
- Installation date
- Current condition

The software tools used may also require other details such as potential treatment types, including unit cost and the expected life of each type of treatment.

Customized programs could potentially compute a number of scenarios for optimized types of treatment and timing relative to asset condition. Some packages can graphically show the change in overall condition of the transportation network for various scenarios, further aiding decision-makers in their selection of an optimal treatment.

3.6 Optimized Level of Service

An optimized level of service is one that takes into consideration:

- Customer expectation,
- Long-term affordability,
- Risk and consequence issues, and

- Alternative options for provision of service.

Level of service is a comparative indicator used to define the standard of service a customer receives; it includes measurements such as the quality of the riding surface, the width/capacity of the road, and the standard of safety measures in place.

An agency will have to consider all the sources of income and projected funding, and optimize the level of service recommendation based the funds available.

4 Know the Rules

4.1 Strategic Goals

Every agency engaging in Asset Management must establish a set of goals and performance targets for their assets. The goals and targets must aim to achieve the most beneficial long-term health of the assets while providing the desired level of service for stakeholders. An agency's strategy should take into account state and local strategic goals as well as the performance targets established the agency.

Having a strategy to meet those goals and performance targets documented and in working order will allow for realizing your goals in the most efficient and cost effective manner.

State Goals

The State Transportation Commission and the Michigan Department of Transportation establish strategic goals for the State of Michigan's surface transportation system. This section refers to those goals set by your State with respect to assets. Sources for information on the state's strategic goals include:

- Five Year Program
- State Long-Range Plan
- State Transportation Improvement Plan
- Michigan Strategic Plan

Changes in standards, e.g. updates to the Michigan Manual of Uniform Traffic Control Devices, or changes to Federal regulations, e.g. Draft Proposed Right-of-Way Accessibility Guidelines (PROWAG), can affect your asset management plan by requiring funds be allocated to that statewide change. These requirements are often non-negotiable and must be incorporated into your processes and goals.

Local Goals

Much like state goals, local goals affect your agency. Local goals may be set by an agency's mission statement, statutory obligations, or as established through a stakeholder involvement process. Whatever the source of your agency's local goals, it is important to document those goals and tailor your decision and reporting processes to achieve those goals.

Performance Targets

It is vital for an agency to establish performance targets for the management of their assets. Performance targets enable the review process and allow you to determine if the selected maintenance strategy is performing as anticipated. Examples of performance targets that an agency have could include maintaining your pavement network to an RSL of 7 years or greater, to begin saving a fraction of

your budget each year for emergency maintenance needs, or simply to expend resources in the most beneficial way possible.

4.2 Legislation, Policy & Standards

A basic understanding of the legislation, policy and standards in place with respect to asset management in the State of Michigan is helpful when establishing your own asset management plan. The following is a summary of the legislation governing asset management in the State of Michigan.

Michigan Public Act 199 of 2007 requires that "The department, each county road commission, and each city and village of this state shall annually submit a report to the Council. This report shall include a multi-year program developed through the asset management process described in this section. Projects contained in the department's annual multi-year program shall be consistent with department's asset management process and shall be reported consistent with categories established by the Council. Projects contained in the annual multi-year program of each local agency shall be consistent with the asset management process of each local road agency and shall be reported consistent with categories established by the Council."

Public Act 338 of 2006 requires that "A City or Village shall not transfer more than 50% of its annual major street funding for the local street system unless it has adopted and is following an asset management process for its major and local street systems…"

In summary, all jurisdictions of the State of Michigan are required by Public Act 199 to adopt and implement an asset management plan though they do not require approval from the Council. Those jurisdictions seeking the ability to transfer funds per Public Act 338 must have approval of their asset management plan from the Council.

4.3 Reporting

Reporting the results of your asset management plan is necessary to effectively analyze the progress of the goals, strategies and overall effectiveness of your agency. There are many ways to report asset management data, such as reporting on the current state of individual assets, on the predicted future of their assets, or with respect to certain projects. Accurate reporting on the management of assets provides a record for understanding performance and a tool for evaluating your asset management strategies.

Agencies in the State of Michigan are required to annually report data about the transportation assets under their jurisdiction. Currently, there are 3 ways to report your agency data to the Council. These reports are required by Michigan's asset management legislation.

Condition Report

A condition report includes the total mileage of the road network and a summary of pavement and bridge conditions. A condition report will also answer two questions: What assets/facilities does your agency own; and, what is their current condition? This report will aid your agency in evaluating the effectiveness of your current and past strategies. Historical data and allows for revision of future strategies. Understanding the

progression of health in your network is beneficial when planning for the future. Consider using RoadSoft to aid in writing up your condition report.

Record of Work

A record of work includes transportation maintenance and operational or improvement activities with locations and associated costs that were performed in the previous year. The Record of Work report is a summary of all work performed on the transportation system during the previous year and all costs associated with the work. This report allows for the comparison between the total labor being consumed and tasks being performed with the overall network improvement. It can also provide a means for comparing actual costs to estimated costs. Project cost estimates for common activities can be reviewed and adjusted for the future.

Multi-Year Program

In accordance with Act 199 of 2007, agencies are required to annually submit all of the work planned for each budget category for the next three years including locations and predicted costs. The Multi-Year Program lists the projects that your agency anticipates completing over the next three years. Development of a multi-year program encourages a shift towards a more strategic and less reactive approach to project selection. With information from your agency, the Council will be able to generate a more accurate assessment of future pavement and bridge conditions.

The Council uses the information from your agency to prepare an annual report for the State Transportation Commission and the Legislature by May 2nd of each year. This report informs the legislature of the status of transportation system performance and the ability of agencies to maintain that system.

4.4 Evaluation of Goals and Performance Targets

Evaluating the performance of assets and management strategies is crucial to an advanced asset management plan. This evaluation allows you to determine whether you are meeting the established goals and whether the assets are performing as you expected. Completing this task will also enable you to clearly communicate with stakeholders regarding the agency's performance.

The inputs to the evaluation include:

- Level of service targets established (refer to section 3.2), and measurement of current levels of service
- The predicted budget required to deliver that level of service through the customized treatments selected (refer to chapter 3)
- State and local goals and performance targets to be monitored as established (refer to section 4.1)
- The current and predicted financial situation (refer to chapter 2)

The outputs of the evaluation include:

- Understanding how well the agency's goals were met.
- Knowing whether the system's performance met the targets.
- Knowing if funding levels are sufficient to achieve your goals and targets.

The last evaluation output mentioned above considers the cost to meet the established goals and performance targets. If the evaluation determined that current funding levels are not sufficient to achieve the goals and targets as established, an agency must take time to review the goals and targets established for the assets.

4.5 Reviewing Your Goals

The purpose of this review is to test whether the strategic goals and performance targets of the organization are still appropriate and achievable. The review considers the evaluation of goals and performance targets (refer to section 4.4). However, it is important to recognize that unsuccessful performance does not mandate a change in goals nor is a change in goals exclusively dependent on not meeting the established goals and targets. Consider the following reasons to review agency goals and performance targets.

Changes in Stakeholder Needs

The needs of our communities are constantly evolving. Fifteen years ago it was uncommon for an agency to consider how a design decision would affect the aging system user; now it is commonplace for a design team to review elderly mobility concerns. Twenty years ago a road maintenance agency may not have considered accommodating non-motorized modes when developing a design; now the state has complete streets legislation. As the needs of our communities—and the expectations of our stakeholders—change it is vital to step back and review our asset management goals to verify that they are consistent with those changing needs.

Changes in Funding Structures

Funding allocation for transportation projects does not have a static structure. The way funding is allocated, and the requirements governing the use of that funding, changes over time. Agencies should conduct a comprehensive review of their goals and performance targets whenever a major change occurs with the way funding is allocated or the way an agency is required to utilize that funding. Some of the goals established by the agency may no longer be achievable, or conversely, some of the goals the agency previously could not set may now be attainable.

Changes in State or Federal Legislation/Policy

Major changes in the state or federal legislation and policies regarding the transportation system will also necessitate a review of an agency's goals. Consider the example of the Americans with Disabilities Act of 1990. This act completely, and permanently, changed the way the stewards of public transportation assets conduct business. As a result of the act, all agencies had to revise the way they spend transportation dollars, accommodate end users, and set priorities.

Changes in Land Use

Over time the nature of a community may change. As land develops, or redevelops, into more (or less) dense land uses, road agencies have to reevaluate the priorities used when establishing their goals. A road agency might find that more emphasis needs to be devoted to non-motorized facilities to connect new neighborhoods or that an area with fewer trip demands might allow for a reallocation of cross section such as a 4-to-3 lane conversion.

5 Decision Making

Decision making is fundamental to all aspects of good asset ownership, effective management, responsible stewardship and long term sustainability. Good decision-making relies on the quality of the people making the decisions, the quality and completeness of the information that they have to base their decisions on, and the robustness and repeatability of the decision-making process being employed.

5.1 Evaluate Decision Process

Decision making processes should be reviewed for effectiveness on a regular basis. Questions such as, who makes certain decisions, when are they made, and what are they based on, should be considered and adjusted as needed.

Current Processes

Consider the current processes that you have in place. What are they? Are your processes documented appropriately? The goal of a well documented process should be that any person could read the process, understand and be able to implement the process. Your current processes may include the means by which your assets data is input into RoadSoft or the methods with which you determine what work should be done where, and when.

Desired Processes

Your current processes may not match your desired processes. What can be done to improve your current processes and make them meet your desired processes more closely? This action can be as simple as more clearly defining your current processes or as involved as writing new processes.

Improvement Gap

Consider the reasons for the gap between current processes as compared to your desired processes. The availability of software may be your issue and investing in the appropriate software would help to bring your data entry process to more closely to reflect your desired process. Maybe the method by which you calculate your mix-of-fixes is not clearly defined and explicitly defining those steps taken to determine your mix-of-fixes could reduce confusion.

5.2 Basic Process Improvement Plan

Task Identification

What goals do you have for your agency? Are they documented? What defines your task? An identified task may include such information as the name of the task, a description of the task or service, an associated cost, and a due date. Software such as RoadSoft can help you organize this information.

Basic Plan Development

The purpose of your basic plan should be to document those tasks and services that need to be performed, and outline the ways in which you plan to address those goals. The basic plan may only include very broadly defined goals over a number of years, e.g. replace all signs older than 15 years over the next 5 years. The tasks can be as general or as specific as needed by your agency.

Implementation

Implementation of your basic plan is dependent on the tasks identified in the plan and the processes defined.

5.3 Prioritized Process & Improvement Plan

Develop Prioritization and Process Tools

You've determined your tasks and set your goals. How does an agency develop a prioritization plan and processes for implementation? RoadSoft is the preferred method for many Michigan agencies to optimize their asset management plans. Of course, you can always develop your own logarithms and equations to optimize the life of your assets, the total health of your asset network, and make the most of your budget.

Budget

The allocation of monies with respect to the maintenance, rehabilitation, and reconstruction of your assets is a function of your prioritization method. Dependent on your mix-of-fixes, all of your funds for the fiscal year may be allocated to maintenance. It is more likely that you use your prioritization method to spread your funds over maintenance, rehabilitation, and reconstruction. Maybe your asset management plan requires at least one rehabilitation or reconstruction project a year. An optimized asset management plan will help in making the most of your funding.

5.4 Collaboration & Integration Plan

Collaboration should occur on many levels with respect to your asset management plan. Internal collaboration and dissemination of ideas and methods helps to maintain standard strategies and reinforces strong communication.

Collaboration can also occur between municipalities, as the sharing of knowledge between agencies will increase the knowledge for the greater good. It allows for agencies to learn from one another's mistakes and reap the rewards of well thought out plans.

Figure 5-1 Illustration of Agency Interaction

Internal

Internally, an understanding of the asset management plan among your agency's employees can only lead to better decision-making, and better decision-making leads to a more effective use of your assets. Widespread knowledge of your asset management plan will likely increase cooperation among your employees as well as increase the sharing of ideas and information.

External

Cooperation between agencies such as the State, County, and local governments can benefit all agencies involved in their asset management plans. Sharing of resources and knowledge between agencies may facilitate group projects with shared costs.

6 Establishing Sustainability

Sustaining your asset management plan is an essential part of responsible stewardship. Taking a candid look at your plan and process, including who is available to collaborate on programs, anticipating changes in demand, and evaluating potential new technologies are useful self-evaluation tools.

6.1 Sustainability Assessment

An agency's asset management plan must be sustained if it is to be a useful strategic tool. The sustainability of the process and plan may only last as long as the funding, so it may be advantageous to look at both the short-term and long-term feasibility of the plan.

If an agency deems the funding available insufficient beyond the current fiscal year, then the Asset Management Plan may never gain the traction it needs to take hold. However, if an agency takes a critical look at their goals, and allows for the graceful degradation of funding sources, they may be able to identify other sources of income—and target certain projects to receive those funds.

Short-term View

Looking at the short-term view may require looking only at the ability to fund current projects, for instance an ongoing safety program devoted to the replacement of pavement markings—something that occurs on an annual or bi-annual basis. Reducing or eliminating funding for these programs may have an immediate or significant impact on your agency's assets.

Mid-term View

Intermediate projects require a different process when evaluating their sustainability. These projects may already be designed, and a year identified for their completion in a Capital Improvement Program, however, their completion may be contingent on planned funds being available.

Long-term View

The long-term view may include decisions about asset replacement, as even the most ambitious rehabilitation and restoration program won't sustain an asset in perpetuity. As future needs and priorities change, an agency must be able to adapt to the requirements of their constituents and the legal requirements governing the assets in their jurisdiction.

Lifecycle cost analyses (previously discussed in chapter 3) are a useful tool in evaluating the funding requirements needed to sustain an asset management plan.

6.2 Program Coordination

Collaboration

Successful program coordination may involve collaborating with other entities to gain the highest possible level of service. This can often be the case where the resulting effort is greater than the sum of the parts.

Possible collaborations could include:

- Public-Private Partnerships
- Adjacent jurisdictions (i.e. other cities or counties)
- Downtown Development Agencies
- Metropolitan Planning Organizations
- Michigan Department of Transportation

Funding Sources

An important component of coordinating an asset management plan is identifying alternate or supplemental sources of funding. Some sources may provide unconditional funding while others would require a match be provided by the agency. If secured, the funds may be ear-marked for targeted improvements, such as safety upgrades or non-motorized facilities. These funds may provide an agency with opportunities for upgrades or capital improvements outside of regularly scheduled programs.

These alternate funding sources could include:

- Local Millage
- Special Assessment District
- Highway Safety Improvement Program (HSIP)
- Federal Grants
- Michigan Transportation Fund (MTF)

6.3 Demand Management

As the asset management plan is a living document, it may be necessary to adapt the strategic plan to include changes in demand or capacity. This could include the need or desire to add:

- Additional lanes
- New roads
- New signals
- Larger bridges
- Additional or larger inlets or storm sewers

A change in demand may stem from other social factors as well. As the population of an area grows, considerations about noise or other environmental concerns may require a fresh look at potential assets. Acoustical barriers may be required to abate noise pollution. Intermediate treatment—including swirl chambers or settling basins—may be needed prior to discharging runoff to natural watercourses.

Not every agency may anticipate a change in demand significant enough to warrant additional assets, but evaluating future needs is an important part of an asset management plan.

6.4 Emerging Technology

Agencies must be mindful of the impacts that emerging technology may have on their assets. Continuing refinements in materials and methods may offer important advances in the construction,

maintenance, and overall durability of an asset. Consider the example below, pertaining to roadway pavements.

Materials

While the materials used in constructing a roadway are, at a basic level, little changed over the course of history, it would be hard to contest that our newly-built roads are stronger and more durable than those that came previously.

The first surfaced roads can be dated to about 4,000 B.C.E. and include stone paved streets at Ur (in modern-day Iraq) and timber roads preserved in swampland in Glastonbury, England. The engineers of ancient Babylon placed the first asphalt surface between 625 and 604 B.C.E, while the first American macadam surface was constructed on the "Boonsborough Turnpike Road" between Hagerstown and Boonsboro, Maryland, in 1823—stagecoaches traversing the road in wintertime covered the 10 mile distance in as long as 7 hours prior to the surfacing.

In 1876, President Grant first sponsored a study on the use of asphalt on roads. Pennsylvania Avenue, in Washington, D.C., was paved with sheet asphalt made from Trinidad Lake asphalt; that pavement remained in excellent condition for 11 years, despite the relative volume of traffic around the White House.

Wayne County, Michigan, built the first mile of concrete highway in the world in 1909, along Woodward Avenue between Six and Seven Mile Roads. Concrete, a technology first used by the ancient Romans, has since been used to construct countless miles of roadways around the world. That first mile of roadway cost $13,537 in 1909[2]—a value of about $326,750 in 2010 dollars. The Florida Department of Transportation estimated that one mile of newly-constructed undivided 2-lane rural roadway with 5-foot paved shoulders costs about $1.47 million[3]—a 4.5-fold increase.

It is not unexpected for a modern concrete roadway to last upwards of 40 years before a total reconstruction of the pavement is required.

Performance

Pavement technologies are continually evolving; every year novel ideas are proposed, tested, and accepted in the mainstream. At the same time, conventional methods—many of which have been used for decades—are being rendered obsolete.

For example, many states have over 20 years of performance with Superpave mixes, but few agencies can report with any degree of certainty the effect these mixes have had on pavement performance. Additionally, the introduction of new materials means that long-term performance data are not available—making it difficult to forecast the future performance of these materials.

An agency must consider the incorporation of emerging—or unknown—technologies when judging the long-term sustainability of their asset management plan.

[2] http://michigan.gov/mdot/0,1607,7-151-9620_11154-103370--,00.html
[3] ftp://ftp.dot.state.fl.us/LTS/CO/Estimates/CPM/summary.pdf