Arizona DOT Highway Asset Management Implementation Plan

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1.0 Introduction

1.1 BACKGROUND

The mission of the Arizona Department of Transportation (ADOT) is to provide a safe, efficient, cost-effective transportation system. To further this mission, ADOT is committed to integrating asset management into its business model. This commitment reflects ADOT's desire to continually improve how it manages its transportation assets over their whole life. In support of the improvement process, ADOT conducted a transportation asset management (TAM) gap assessment for highway assets as part of a Federal Highway Administration (FHWA) project. The FHWA is assisting 10 state DOTs with this type of assessment. ADOT's objectives for the assessment were to compare current practices to the state-of-the-art, identify and prioritize gaps, and define a set of activities for addressing the highest priority gaps. This report documents the assessment and provides implementation guidance.

ADOT manages a wide range of assets to meet the public's transportation needs. However, as an initial step, this implementation plan focuses on ADOT's bridges and pavements. ADOT expects to expand its TAM practices to other types of assets over time.

This implementation plan was developed in four steps:

- **Step 1. Conduct self-assessment survey.** Nearly 50 ADOT staff members completed a TAM self-assessment survey. The survey was based on the one provided in Volume I of AASHTO's *Transportation Asset Management Guide*. The survey defines asset management best practices and asks respondents to rate the degree to which DOT practices are consistent with these practices. Participants were also asked to rate the degree to which they should be consistent.

- **Step 2. Conduct interviews**. Nearly 35 staff members participated in a series of face-to-face interviews. The objective of these interviews was to discuss existing practices in more detail.

- **Step 3. Facilitate self-assessment workshop.** Based on the results of the self-assessment survey and the interviews, the consultant team identified an initial set of gaps and presented them to ADOT. The objective of the workshop was to discuss and prioritize the gaps, and to discuss options for addressing them.

- **Step 4. Develop implementation plan.** This document is based on the results of the first three steps. The implementation plan is designed to provide ADOT guidance on improving its asset management program. The plan can also be used as one of the components for ADOT's initial transportation asset management plan (TAMP).

It is recommended that ADOT revisit this plan periodically and revise it to reflect accomplishments, emerging challenges, unexpected opportunities, and evolving priorities.

1.2 IMPLEMENTATION PLAN ORGANIZATION

The remainder of this report is organized as follows:

- Section 2 defines asset management and presents a series of business needs that reflect best practices;

- Section 3 summarizes current asset management practice at ADOT;

- Section 4 establishes a vision and goals for implementing TAM;

- Section 5 recommends an asset management work plan with practical implementation steps that support the vision and goals.

2.0 Asset Management Overview

2.1 WHAT IS ASSET MANAGEMENT?

The Moving Ahead for Progress in the 21st Century Act (MAP-21) defines transportation asset management (TAM) as:

> A strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the lifecycle of the assets at minimum practicable cost. (23 U.S.C. 101(a)(2), MAP-21 § 1103, July 2014)

2.2 THE PRINCIPLES OF ASSET MANAGEMENT

TAM should not be considered as a separate new program or initiative, overlaid upon existing procedures, and in competition with other items on agency's agenda. Rather, it represents a way of doing business. In this view, the principles of good asset management can be visualized as affecting simultaneously, the philosophy, processes, and technical tools that underlie ADOT business practices.

The following statements describe good TAM:

- TAM is a philosophy

- TAM is a process to fuel decision making and business improvement

- TAM is a set of management tools; and

- TAM is a resource allocation and utilization process.

TAM Is a Philosophy

- Asset management represents an approach to managing infrastructure that is strategic and proactive, and places a premium on good information in all aspects and in all agency units.

- Asset management is holistic. It entails a comprehensive view across a range of assets. It encourages consideration of a full range of options to solve problems or meet needs. Tradeoffs are explicitly considered among programs, modes, or strategies.

- Asset management is driven by policy goals and objectives based upon performance. Strategies are analyzed in terms of objective assessments of costs, benefits, long-term performance, risks to both agency and system

performance, and other impacts on the transportation system and levels of service provided to transportation users.

- Asset management takes a long-term view of infrastructure performance and cost. The benefits of different actions are assessed throughout the infrastructure service life, applying economic as well as technical criteria.

- Asset management is proactive. An agency has the latitude to make decisions based on merit and consider factors such as cost effectiveness, risks, and practical considerations, among others.

- Asset management policy is influenced and informed by good information. This information describes current and projected system condition and performance that would result from different policies or strategies. It also encompasses user perceptions of system condition and performance, as obtained through surveys or focus groups.

- Asset management is explicit and visible, and serves to clarify and communicate the process and outcomes of resource allocation and program delivery. Asset management, by virtue of its rational and objective qualities, demystifies and fosters confidence in those decision processes that influence the allocation and utilization of scarce resources. In doing so, asset management fosters increased stakeholder participation, buy-in, and adherence to adopted strategies and decisions.

- Viewed as "a way of doing business," asset management is pervasive, affecting the business practices of every organizational element involved in the functions to which it is applied.

TAM is a Process to Fuel Decision Making and Business Improvement

The principles of good asset management can suggest ways in which ADOT's decision making, business processes, and organizational roles can be strengthened. These process improvements can occur in those activities prior to budget approval – i.e., planning and program development – and in the program delivery and system performance monitoring phases subsequent to budget approval. Major principles governing process improvements are listed below.

- Investment choices and decisions on allocating and applying resources are policy and performance-driven. Procedures to reach these decisions are consistent with objective information and criteria based on merit. Performance measures consistent with policy goals and objectives are established for management review of both system performance and program delivery. TAM takes a long-term view of performance and manages assets over the whole life.

- Investment choices and decisions on allocating resources are based upon explicit tradeoffs among modes, programs, or strategies. Tradeoffs assess the impacts of more or less investment in a mode, program, or strategy, and help to craft final recommendations on how resources will be allocated across

competing needs. Managers also understand the implicit tradeoffs in their programs and budgets, and the consequences thereof.

- Asset management entails the translation of policies and plans into optimized investment strategies, and the translation of investment strategies into optimized program delivery. The essence of asset management involves a combination of resource allocation decisions and program delivery strategies that are optimized in relation to specific policy-driven criteria and these decisions/strategies consider risk over the entire life-cycle of an asset and over the entire network.

- Organizational roles and responsibilities regarding asset management are developed to encourage more strategic and integrated approaches. While strong vertical organizational units may exist to maintain core expertise, managed business processes and decisions involve wider participation.

- Asset management is interdisciplinary. Decisions on investment choices and resource allocation are based upon expertise and judgment from several quarters of an Agency. Assets are managed for delivery of the desired level-of-service for the least practical cost.

- Asset management requires effective communication within and outside the Agency. Within the Agency, strong communication channels are needed both across divisions and disciplines as well as within divisions.

- External communications need to inform policy-makers and other stakeholders of the status of transportation assets and recommended policies and their benefits.

- The Agency strives for more effective program delivery. The Agency explores innovative methods to deliver the range of projects and services required. All available methods are considered, including use of departmental employees, intergovernmental agreements, outsourcing or managed competition, and privatization.

TAM is a Set of Management Tools

Effective management systems and complete, current, and accurate information on transportation infrastructure are practical necessities in meeting the policy and process requirements of asset management. Good asset management implies a systematic, integrated approach to project selection, analysis of tradeoffs, and program and budget decisions. It also implies that the right information be available to the right levels of management at the right times. The principles below support the availability and application of better information to make better decisions in asset management.
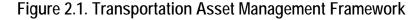
- Complete, current, and accurate information on transportation infrastructure assets, including descriptions, location, usage, unique or specialized characteristics, functional and other classification, and data needed for management systems.
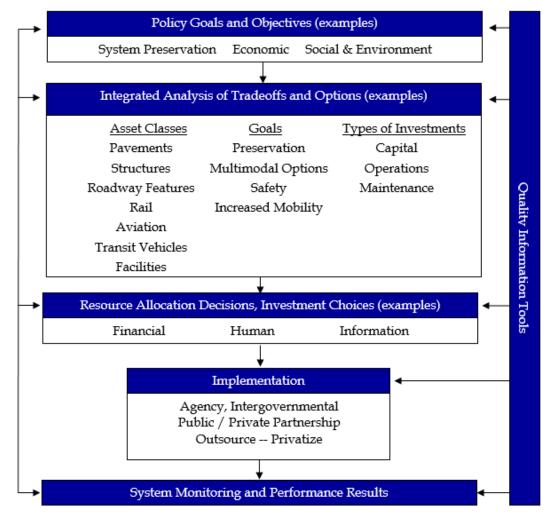
- An appropriate suite of management systems and databases informs the Agency of the status, trends, and needs regarding its infrastructure assets. Typical capabilities of these systems include the following:

- Organization of information within databases describing infrastructure inventory, condition, and performance.

- Information ownership identifying the business group responsible for updating asset information including condition ratings, frequency of data updates, detailed condition rating methodology, and the method of data collection.

- Metadata containing a dictionary of the data fields collected for each asset, data values, data validation rules, linear referencing system used, and data flow/integration with other information systems.

- Analytic models that predict the rate of future change in condition or performance, enabling the agency to forecast future infrastructure needs.

- Decision rules or procedures for applying treatments or actions to maintain, preserve, rehabilitate, replace, or expand transportation infrastructure, with analytic models of resulting costs, benefits, and other impacts including an emphasis on a preservation based approach to strategy implementation.

- Reports tailored to different organizational levels of management, including senior and executive levels, as well as for public distribution.

- Information on system performance in terms of both proposed targets and values actually achieved in the field.

- Specialized technical applications that support an Agency's asset management procedures. These will vary by Agency, but may include advances such as use of geographic information systems (GIS) as a system/data integration platform, economic analysis applications (e.g., generalized life-cycle benefit-cost procedure), trade-off analysis between assets, and other decision-support tools.

- Applications that assist in program and service delivery, including financial applications (e.g., to compute "total" or "true" cost of Agency and contracted services), and management systems for construction project pipeline and construction delivery.

TAM is a Resource Allocation and Utilization Process

Asset management is, at its core, a process of resource allocation and utilization. Resources in this context are interpreted broadly, encompassing financial, human, information, material, and equipment inputs to the management of the physical transportation infrastructure. The process of assigning or distributing these resources and applying them to the Agency's mission is likewise interpreted broadly, encompassing not only the traditionally understood functions in

planning, program development, and budget approval, but also program delivery, system monitoring, data analysis, and input to policy formulation.

Figure 2.1 illustrates a strategic, integrated, systematic, and interdisciplinary approach to asset management for physical transportation infrastructure. The approach is cast as a resource allocation and utilization process. The entries in Figure 2.1 are examples, defined broadly and comprehensively to illustrate how the process could work in a general case.

Figure 2.1. Transportation Asset Management Framework

2.3 ASSET MANAGEMENT BUSINESS NEEDS

As described above, transportation asset management is a comprehensive process that spans across several agency departments, and addresses decisions that the agency makes throughout an asset's life. Given this broad reach, it is informative to break asset management practice down into a set of concrete business needs. These needs reflect state-of-the-art asset management decision making. The following needs are based on MAP-21 requirements, guidance provided through national research efforts, and best practices by DOTs throughout the U.S. They are organized around the TAMP requirements in MAP-21. The needs provide a basis for assessing existing practices at ADOT and identifying potential business process enhancements.

To have a state-of-the-art asset management program, ADOT needs to:

Inventory and Condition

1. Have access to complete, current, and accurate inventory of bridges and pavements on the NHS and State-owned system.

2. Have access to historic condition information at both the network and asset levels.

3. Have access to complete and accurate information regarding current passenger and commercial vehicle traffic volumes.

4. Project future traffic volumes and assess their impact on network conditions.

Asset Management Objectives and Measures

5. Document goals that guide resource allocation.

6. Understand the public's expectations for the transportation system.

7. Define performance measures to communicate system condition, aid in the allocation of funds to programs, and identify and prioritize projects.

Performance Gap Identification

8. Understand the relationship between funding levels and future asset conditions.

9. Develop condition targets.

Lifecycle Cost Considerations

10. Incorporate lifecycle cost considerations when modeling future asset condition.

11. Incorporate lifecycle cost considerations when selecting maintenance activities and construction projects.

12. Define key work activities, document their typical unit costs, and detail their ideal timing and sequencing.

13. Determine the long-term cost implications of adding new assets (i.e., maintenance costs) and consider these costs when prioritizing network expansion activities (e.g., highway, pedestrian, or bicycle facilities).

14. Document how projects are prioritized and selected for construction.

Risk Management

15. Identify agency-level risks that could impact implementation of asset management programs (e.g., funding uncertainty and major weather events).

16. Identify program-level risks that could impact implementation of specific programs, such as the bridge program (e.g., an age distribution of the bridge network that will result in a large number of bridges reaching the end of their design life at the same time).

17. Evaluate the agency- and program-level risks in terms of their likelihood of occurrence, the consequences should they occur, and use the results to prioritize the risks.

18. Identify strategies for mitigating the highest priority risks.

Financial Planning

19. Have access to complete and accurate information regarding historic expenditures at the project, work type, and program levels.

20. Project future funding that will be available for asset management over a minimum timeframe of 10 years.

21. Explicitly consider the relationship between the capital and maintenance programs, and use this information to inform budgeting decisions.

22. Allocate the available funds to program areas based on the objectives from Item #5, public perception from Item #6, performance implications defined in Item #8, lifecycle cost considerations from Items #10 and #13, and risk mitigation strategies from Item #18.

23. Document the entire resource allocation process and timeline.

24. Determine the transportation network's current value, and describe how funding levels and investment strategies will impact its future value.

Investment Strategies

25. Compile, prioritize, and communicate investment strategies that define how the agency will use the funds identified in Item #22.

Asset Management Systems

26. Use state-of-the-art asset management systems to conduct the analysis required for the above business needs.

3.0 TAM at ADOT

This section summarizes current (2014) TAM practice at ADOT for its pavements and bridges. The consultant team derived the information in this section from an online survey, in-depth interviews with ADOT staff, and the results of ADOT's TAM self-assessment workshop.

Table 3.1 presents an asset management maturity scale presented in Volume II of AASHTO's *Transportation Asset Management Guide*. This scale provides a convenient mechanism for assessing existing asset management practices.

Table 3.1 Transportation Asset Management Maturity Scale

TAM Maturity Scale Level	Maturity Level Number	General Description
Initial	1	No effective support from strategy, processes, or tools. There can be lack of motivation to improve.
Awakening	2	Recognition of a need and basic data collection. There is often reliance on heroic efforts of individuals.
Structured	3	Shared understanding, motivation, and coordination. Development of processes and tools.
Proficient	4	Expectations and accountability drawn from asset management strategy, processes, and tools.
Best Practice	5	Asset management strategies, processes, and tools are routinely evaluated and improved.

Source: AASHTO Transportation Asset Management Guide Volume II, 2011

Table 3.2 provides an assessment of ADOT's asset management maturity using the business needs defined in Section 2. This information is used as the basis for the work plan presented in Section 5.

Table 3.2   Assessment of ADOT TAM Practices

Category	#	Business Need	Bridge Maturity (1 to 5)	Pavement Maturity (1 to 5)	Comments
Inventory and Condition	1	Have access to complete, current, and accurate inventory of bridge and pavements on the NHS and State owned system	5	4	ADOT conducts regular bridge inspections that are consistent with best practices. It collects pavement roughness data and conducts visual pavement inspections. Currently data is collected on a sampling basis, but ADOT is considering expanding to the complete system. Overall, staff have confidence in the underlying data, but have identified the need to improve access and consolidate pavement data. In 2015, ADOT developed the Arizona Transportation Asset Management System, a geospatial tool that allows the user to access data from multiple sources.
Inventory and Condition	2	Have access to historic condition information at both the network and asset levels	4	3	ADOT conducts regular bridge inspections that are consistent with best practices. It collects pavement roughness data and conducts visual pavement inspections. Currently data is collected on a sampling basis, but ADOT is considering expanding to the complete system. Overall, staff have confidence in the underlying data, but have identified the need to improve access and consolidate pavement data. In 2015, ADOT developed the Arizona Transportation Asset Management System, a geospatial tool that allows the user to access data from multiple sources.
Inventory and Condition	3	Have access to complete and accurate information regarding current passenger and commercial vehicle traffic volumes	5	5	ADOT has confidence in current traffic counts. Staff identified a need for improve future projections.
Inventory and Condition	4	Project future traffic volumes and assess their impact on network conditions	3	3	ADOT has confidence in current traffic counts. Staff identified a need for improve future projections.
Asset Management Objectives and Measures	5	Document goals that guide resource allocation	3	3	The lack of clear goals that guide resource allocation decisions was cited as a gap by several ADOT staff.
Asset Management Objectives and Measures	6	Understand the public's expectations for the transportation system	3	3	ADOT staff flagged this as an area for improvement in the online survey.

Category	#	Business Need	Bridge Maturity (1 to 5)	Pavement Maturity (1 to 5)	Comments
Asset Management Objectives and Measures	7	Define performance measures to communicate system condition, aid in the allocation of funds to various programs, and identify and prioritize projects	5	3	ADOT uses bridge performance measures to aid in decision making. ADOT has pavement performance measures but staff noted that they are not tied directly to decision making or resource allocation.
Performance Gap Identification	8	Understand the relationship between funding levels and future asset conditions.	3	3	ADOT staff identified developing the ability to model future asset condition as a high priority. This capability will be available for pavements once ADOT's new pavement management system is implemented. ADOT has begun the procurement process for this system.
Performance Gap Identification	9	Develop condition targets	3	3	ADOT has defined targets for bridges and pavements. However, they are not formal targets that drive decision making.
Lifecycle Cost Considerations	10	Incorporate lifecycle cost considerations when modeling future asset condition	3	3	Same as #8. ADOT can not currently model future bridge or pavement condition. It has identified this as an opportunity for improvement and has the data required to support this type of analysis.
Lifecycle Cost Considerations	11	Incorporate lifecycle cost considerations when selecting asset management projects	4	3	ADOT uses bridge condition data to identify and prioritize bridge projects. ADOT's priority for its bridge program is replacing bridges with a sufficiency rating less than 50. ADOT identifies and prioritizes pavement projects based on visual inspections and engineering judgment. The process is based largely on a worst-first approach. ADOT has made progress in integrating the pavement capital program with its maintenance program.
Lifecycle Cost Considerations	12	Define key work activities, and document the typical unit cost and ideal timing	2	2	ADOT staff expressed a strong desire to more formally assess potential preservation activities such as crack sealing pavements.
Lifecycle Cost Considerations	13	Determine the long-term cost implications of adding new assets and consider these costs when prioritizing network expansion activities	2	2	ADOT staff flagged improvement in this area as a priority because ADOT is actively expanding the transportation system.
Lifecycle Cost Considerations	14	Document how projects are prioritized and selected for construction	2	2	ADOT staff identified improving the transparency and understanding of the project selection process as a priority.

Category	#	Business Need	Bridge Maturity (1 to 5)	Pavement Maturity (1 to 5)	Comments
Risk Management	15	Identify agency-level risks that could impact implementation of asset management programs	2	2	ADOT considers risk management concepts in some its business practices. For example, it considers Sufficiently Rating when prioritizing bridges. This measure captures aspects of the likelihood and consequences of the risk of bridge failure. However, ADOT does not have a systematic, formal process for evaluating risks associated with its asset management programs.
Risk Management	16	Identify program-level risks that could impact implementation of specific programs	3	2	ADOT considers risk management concepts in some its business practices. For example, it considers Sufficiently Rating when prioritizing bridges. This measure captures aspects of the likelihood and consequences of the risk of bridge failure. However, ADOT does not have a systematic, formal process for evaluating risks associated with its asset management programs.
Risk Management	17	Evaluate the agency- and program-level risks in terms of their likelihood of occurrence, the consequences should they occur, and use the results to prioritize the risks	3	2	ADOT considers risk management concepts in some its business practices. For example, it considers Sufficiently Rating when prioritizing bridges. This measure captures aspects of the likelihood and consequences of the risk of bridge failure. However, ADOT does not have a systematic, formal process for evaluating risks associated with its asset management programs.
Risk Management	18	Identify strategies for mitigating the highest priority risks	3	2	ADOT considers risk management concepts in some its business practices. For example, it considers Sufficiently Rating when prioritizing bridges. This measure captures aspects of the likelihood and consequences of the risk of bridge failure. However, ADOT does not have a systematic, formal process for evaluating risks associated with its asset management programs.
Financial Planning	19	Have access to complete and accurate information regarding historic expenditures at the project, work type, and program levels	4	4	ADOT has information on historic spending at the project level. It would take some effort to categorize these expenditures by program though because the underlying purpose of a project (e.g., pavement preservation) is not always clear.
Financial Planning	20	Project future funding that will be available for asset management over a minimum timeframe of 10 years	5	5	ADOT is confident with its projections for the state portion of the transportation budget, but not the Federal portion.

Category	#	Business Need	Bridge Maturity (1 to 5)	Pavement Maturity (1 to 5)	Comments
Financial Planning	21	Explicitly consider the relationship between the capital and maintenance programs, and use this information to inform budgeting decisions	2	2	Similar to item #12. There is a desire to formally assess potential preservation activities and to improve coordination between the capital and maintenance programs.
Financial Planning	22	Allocate the available funds to program areas based on the objectives from Item #5, public perception from Item #6, performance implications defined in Item #8, lifecycle cost considerations from Items #10 and #13, and risk mitigation strategies from Item #18	3	3	There is a strong desire to improve the resource allocation process. ADOT is working to improve in this area through the long range planning process, which will include elements of scenario planning, performance-based planning, and risk analysis.
Financial Planning	23	Document the entire resource allocation process	2	2	ADOT staff expressed a desire to better document how decisions are made and to develop a single, complete picture of the resource allocation process.
Financial Planning	24	Determine the transportation network's current value, and describe how funding levels and investment strategies will impact its future value	3	3	ADOT assesses network value through the GASB-34 process based on the modified approach, which addresses asset condition. However, ADOT does not consider this information useful when making asset management decisions.
Investment Strategies	25	Compile, prioritize, and communicate investment strategies that define how the agency will use the funds identified in Item #22	2	2	ADOT has not formally identified strategies. Also, related to item #21, there is an opportunity to improve existing strategies by incorporating additional preservation strategies and enhancing the coordination between the maintenance and capital programs.
Data and Management Systems	26	Use state-of-the-art asset management systems to conduct the analysis required for the above business needs.	3	4	ADOT is in the process of implementing a new pavement management system, which will be in line with best practices. ADOT has plans to implement AASHTO's bridge management system.

4.0 TAM Vision and Goals

This section defines a vision for risk based TAM at ADOT, and presents a set of goals to guide its implementation.

4.1 TAM VISION STATEMENT

The following vision statement combines ADOT's mission statement with MAP-21's definition of asset management.

"Transportation asset management at ADOT is a strategic and systematic process of operating, maintaining, and improving Arizona's transportation system. ADOT will identify a structured sequence of actions that will enable it to cost effectively achieve and sustain a desired state of good repair, and to provide a safe and efficient transportation network."

The TAM program will support the development of ADOT's long range plan. The structured evaluation of system conditions, performance targets, life cycle cost considerations, risks, and funding scenarios will inform the development of the 5-year program, and enable ADOT to cost effectively achieve its mission.

4.2 TAM GOALS

The goals of the TAM program over the period 2015-2020 are as follows:

- Create a culture through training and communication where TAM is viewed as the way of doing business.

- Develop policies, goals and performance targets that inform asset management decisions.

- Create a process that enables ADOT to develop budget requests based on expected system conditions, and communicate the implications of underfunding preservation activities.

- Find a balance between proactive, preservation-first and reactive, worst-first strategies.

- Over time, expand the asset management program to other priority assets beyond pavements and bridges.

- Provide ADOT staff with improved access to high quality, complete asset data and information. This has largely been accomplished by the completion of the Arizona Transportation Asset Management System. This system will go into production mode by the end of 2015.

- Incorporate risk into the TAM process.

- Improve the coordination between the capital and maintenance programs in order to ensure that highway assets are being managed as cost effectively as possible throughout their whole life. Progress has been made toward this end by the incorporation of the pavement capital program in the maintenance program.

- Enhance ADOT transparency and accountability.

5.0 TAM Work Plan

This section presents an asset management work plan for ADOT. It describes the following practical steps that support the vision and goals defined above.

- Initiative 1. Develop a TAM Strategic Plan;

- Initiative 2. Analyze Asset Management Constraints;

- Initiative 3. Develop Initial Transportation Asset Management Plan;

- Initiative 4. Improve Data Access and Sharing;

- Initiative 5. Enhance the Ability to Analyze Pavements and Bridges;

- Initiative 6. Improve Coordination between the Maintenance and Capital Programs;

- Initiative 7. Incorporate Performance into the Budgeting Process;

- Initiative 8. Integrate Risk Management into the Asset Management Process; and

- Initiative 9. Expand TAM Practices to Assets Beyond Bridges and Pavements.

The plan also includes a timetable and a preliminary cost estimate for each activity. Implementing the work plan will require a mixture of indirect and direct costs. Indirect costs cover the resources required for current ADOT staff to perform work. Direct costs cover the resources required to engage consultants. Consultants may be brought in to add expertise or to address workload constraints within ADOT. This work plan represents one implementation scenario, which combines both internal and outsourced work. For the majority of the initiatives, the plan provides a preliminary cost estimate (low <$50K, medium = $50–$100K, and high >$100K) associated with engaging a consultant. Indirect costs have not been estimated. The final cost of implementing the work plan will decrease if ADOT performs more work in-house and increase if consultants are relied upon more heavily.

The work plan makes no presumption of the relative priority of this initiative with respect to other projects at ADOT. Rather, it presents activities, timeframes, and budgets as if the implementation of asset management at ADOT has full financial backing.

Implementing TAM will take patience. In some cases, the recommendations will result in a fundamental shift in the way ADOT does business. TAM at its core is an ever evolving continuous improvement process. To that end, several of the initiatives involve initial steps in the developing approaches, frameworks and strategies that will be implemented on an ongoing basis.

5.1 RECOMMENDED INITIATIVES

Initiative 1. Develop a TAM Strategic Plan

The objective of Initiative 1 is to formalize and document how TAM will be implemented at ADOT. This brief document should build from ADOT's TAMP Work Plan by taking a broader view of asset management that goes beyond development of the initial TAMP. The brief strategic plan should do the following:

Include the goals and objectives defined in Section 4 of this document.

- Define which assets will be included in the TAM effort. ADOT's initial focus will be all state-owned pavements, pavements on the expanded NHS, and all bridges over 20 feet. Over time, it will expand asset management techniques to other priority assets.

- Identify a TAM champion. The champion should be someone from the senior management team that is responsible for ensuring that effort has executive support.

- Identify a TAM coordinator. The coordinator will be responsible for the day-to-day oversight of implementation activities and for working with the various groups throughout ADOT that will be involved in them. The TAMP work plan identifies the State Asset Management Engineer for this role. It is recommend that this responsibility expand beyond TAMP development.

- Identify a TAM steering committee. Again, the TAMP work plan defines an Asset Management Steering Committee, who's responsibility should be extended beyond the TAMP.

- Present a TAM communications plan. This plan should identify who requires TAM communication (Legislature, within the Agency, partners including MPOs and municipal agencies), the type of communication each stakeholder requires, the frequency, communications channels, and key messages.

- Present a TAM training plan. This plan should identify who requires TAM training, the type of training each stakeholder requires, and an approach for providing the training. Examples include developing ADOT specific training materials and taking advantage of training materials from the FHWA National Highway Institute (NHI).

Timing: 2 months

Preliminary Cost Estimate: Indirect/consultant (low)

Initiative 2. Analyze Asset Management Challenges and Constraints

The objective of Initiative 2 is to assess the following issues that impact ADOT's asset management practices:

- Geographic-based allocation policies. A significant portion of ADOT's capital budget is allocated geographically based on a Resource Advisory Committee (RAAC) formula that was established in 1999. It is recommended that ADOT explore scenarios in which this formula is replaced with a more performance-based driven approach, and then communicate the findings to decision makers in terms of the performance implications of the current approach.

- MPO programming processes. Arizona's two biggest metropolitan planning organizations (MAG and PAG) are responsible for programming projects on a significant portion of Arizona's National Highway System (NHS). It is recommended that ADOT review these programming processes, compare them to best practices in asset management, and work with the MPOs to make enhancements.

- Definition of the NHS. MAP-21 clearly identifies the NHS as a priority portion of the Nation's highway system. There is significant concern by ADOT staff about the current make-up of the NHS in Arizona. In some instances, staff feel the NHS does not include some priority routes in the state. In other instances, staff feel the NHS includes routes that are not priorities. Related to the MPO issue described above, there are also issues related to portions of the NHS that are not owned by ADOT. These issues include decision making processes and data collection protocols. It is recommended that ADOT assess the State's NHS from the perspective of system priorities and asset management decision making.

- Highway expansion projects. For the past two decades, ADOT has significantly expanded Arizona's highway system to meet the demand of the traveling public. This focus has helped to shape the culture of the agency. From an asset management perspective, when large expansion projects are interjected into the program process, they take away from the resources that can be used to operate and maintain existing system. They also increase the long term costs of maintaining the transportation system. It is recommended that ADOT analyze the impact of highway expansion projects in terms of performance of existing assets and the life cycle costs of the highway system.

As part of this initiative, it is recommended that ADOT conduct a detailed review of these issues to better quantify their implications, develop an approach for communicating their impact, and identify strategies for addressing them. Implementing the resulting strategies would take a sustained effort, as they may represent significant changes to how ADOT operates.

Timing: 6 months

Preliminary Cost Estimate: Internal/consultant (med) for initial review

Initiative 3. Develop Initial TAMP

MAP-21 requires State DOTs to develop a risk-based transportation asset management plan (TAMP) that address the following elements at a minimum:

- A summary listing of the pavement and bridge assets on the NHS in the State, including a description of the condition of those assets;

- Asset management objectives and measures;

- Performance gap identification;

- Lifecycle cost and risk management analysis;

- A financial plan; and

- Investment strategies.

MAP-21 requires states to have developed and implemented a NHS asset management plan by the second fiscal year beginning after the Secretary of Transportation establishes by regulation the process for asset management plan development. From experience with three States involved in a FHWA Pilot Study, this TAMP development process takes about a year. Examples from the three FHWA Pilot States are available on FHWA's Asset Management website.

In addition to meeting the requires of MAP-21, the TAMP development process will provide ADOT a vehicle for making the initial steps in many areas flagged for improvement during this assessment. Examples include, documenting how funds are allocated and projects are prioritized, setting fiscally constrained performance targets, and assessing risks related to the asset management program.

ADOT has already drafted a work plan for TAMP development. The next step is to secure the resources needed to implement it. Some states are developing their TAMP with internal resources (examples include Georgia and Wyoming). Others are using outside consultants to support the process (examples include Colorado, Minnesota, Nevada, and Ohio). Even with outside help, this process will require significant time and energy by ADOT staff.

Timing: 13 months

Preliminary Cost Estimate: Indirect/consultant (high, $200-250K)

Initiative 4. Improve Data Access, Sharing and Mapping

ADOT has made recent advancements in data and information systems related to asset management. In addition, it has several ongoing efforts aimed at further improving these resources. It is recommended that ADOT build off these efforts to ensure that decision makers can easily access data and information needed to support asset management decisions.

This initiative includes the following activities:

1. Identify and document data and information needed to support the asset management process. What data is needed? How often? In what format? And by whom?

2. Once the new linear reference system (LRS) has been implemented, work to reference the key data sets identified in activity #1.

3. Develop a data governance plan that identifies responsibility for collecting, managing and updated core data items, defines a source of record for each item, and documents a data QA/QC process.

4. Develop a systems architecture that illustrates how core systems interact, and defines how systems should related to each other so that no additional geocoding is necessary when moving data from one system to another.

5. As new systems come on line, such as a new pavement management system and bridge management system, ensure that they are implemented in a way that supports the overall systems architecture.

6. Develop a web-based Geographic Information System (GIS) that enables staff to querying data from multiple sources and generate custom maps. This step is completed as part of AZ-TAMS.

Timing: 24 months

Preliminary Cost Estimate: Internal/consultant (high)

Initiative 5. Enhance the Ability to Analyze Pavements and Bridges

ADOT currently use management systems for storing and managing inventory and condition data. Its asset management practices could be significantly improving the analytical capability of these systems. Towards this end, ADOT plans to implement AASHTO's bridge management system and is in the process of implementing a new pavement management system. It is recommended that ADOT continue these efforts so that it can: evaluate the relationship between funding levels and future conditions, identify treatments based on an analysis of lifecycle costs, and determine the optimal split between proactive, preservation activities and reactive activities aimed at addressing assets that are already deficient. Once the systems are implemented, it is recommended that ADOT work to update its planning and programming processes to take advantage of the new analytic capabilities.

Timing: 12 months

Preliminary Cost Estimate: Internal/consultant (high).

Initiative 6. Improve Coordination between the Maintenance and Capital Programs

At its core, asset management is about identifying the right treatment for the right asset at the right time. For example, bridge maintenance activities that slow deterioration rates can delay the need for more significant bridge rehabilitation projects, improve long term bridge performance, and decrease the long term costs of managing the State's bridges.

In some cases, the "right" treatment will fall within the maintenance program. In others, it will fall within the capital program. This initiative is aimed at taking a comprehensive view of treatments, and minimizing budget and organizational constraints to implement them. It involves the following activities:

1. Identify the tool kit of strategies for most effectively managing bridges and pavements throughout their whole life.

2. Determine the most efficient way to implement each strategy. For example, through the maintenance program or through the capital program; or with internal forces and/or contractor forces.

3. For strategies flagged for implementation through the maintenance program, pursue funding and ensure that ADOT has the training, equipment, and staffing capacity to implement them.

4. As ADOT implements a new pavement management system, identify opportunities for maintenance staff to use this system to support the maintenance budget process and to identify appropriate pavement activities; and for maintenance activities to be incorporated back into the system so that they can be incorporated into the pavement modeling process.

The first steps could be accomplished through a series of workshops where ADOT staff share and compare maintenance and capital strategies, and discuss the ideal asset management approach. Step #3 will require a sustained effort. Developing and communicating the initial toolkit will provide ADOT with the groundwork required for this longer effort.

Timing: 12 months for steps 1, 2 and 4; ongoing for step 3

Preliminary Cost Estimate: Internal/ consultant (low) for steps 1, 2 and 4; internal for step 3.

Initiative 7. Incorporate Performance into the Budgeting Process

The objective of this initiative is to encourage a more performance-based approach to the overall planning and programming functions at ADOT. In this context, "planning and programming" refers to an agency-wide process rather than a project specific process. To meet this objective, it is recommended that ADOT complete the following activities:

- Use the PMS and BMS described in Initiatives 6 to analyze future asset conditions based on various funding scenarios.

- Use these scenarios to inform the budgeting process, and to establish fiscally constrained network level performance targets.

- Develop guidelines that assist ADOT with making decisions on when an asset should be considered for replacement, rehabilitation, and preventive maintenance. For example, when should a particular section of roadway be replaced rather than maintained in order to meet the targets cost effectively?

- Communicate the need for adequate preservation funding levels to policy-makers, and the implications of underfunding the system.

- Develop processes and procedures that support coordinated project programming.

- Update the existing performance reporting process to reflect the new targets and track progress towards them.

Timing: It is recommended that ADOT perform an initial version of these activities as part of the TAMP development process described in Initiative 3. From there, the process is ongoing, so that ADOT can make adjustments to its measures, targets, and business process over time.

Preliminary Cost Estimate: Initial costs are included in Initiative 3. Going forward, the costs would be largely internal.

Initiative 8. Integrate Risk Management into the Asset Management Process

Decisions about what work to perform on an asset can be driven by a number of factors. Examples include condition thresholds, performance targets, policies and priorities, lifecycle cost considerations, project delivery considerations (e.g., work on drainage features while resurfacing a roadway), and risk considerations (e.g., strengthen bridges in a seismic zone). The objective of this initiative is to improve ADOT's asset management process by integrating risk management into it.

This initiative entails developing a risk management process to account for agency-level and program-level risks related to asset management. It is recommended that the TAMP described in Initiative 3 include an initial risk register that identifies priority risks and defines mitigation strategies for them. This is an important first step. ADOT will be able to use this register to communicate key risks and track mitigation efforts.

Longer term, ADOT should develop a more comprehensive approach for considering risk in the asset management process. For example, ADOT could evaluate funds required for priority risk mitigation strategies during the budgeting process. Another option is for ADOT to consider risk when it prioritizes potential bridge and pavement projects, and/or when it defines investment strategies.

Initiative 8 entails the following steps:

1. Compile examples of how other agencies have incorporated risk into their asset management program.

2. Identify ADOT's objectives and priorities for a risk management program.

3. Develop a custom risk management framework that meets these needs.

4. Implement the framework through subsequent planning and programming cycles.

Timing. 6 months for steps 1 through 3; step 4 is ongoing

Preliminary Cost Estimate. Internal/consultant (medium) for steps 1 through 3

Initiative 9. Expand TAM Practices to Assets Beyond Bridges and Pavements

ADOT's asset management practices are most mature for bridges and pavements. The objective of Initiative 9 is to extend these practices to other assets. During the asset management gap assessment effort, ADOT staff identified the following assets as potential priorities: culverts, retaining walls, rockfall mitigation sites, and signs.

Initiative 9 involves the following steps:

1. Finalize the list of priority assets.

2. For each priority asset type, determine which elements of TAM should be addressed and how. The elements include: inventory, performance measures, current condition, target condition, risk assessment, life cycle cost considerations, funding, and investment strategies. The approach for each element could vary by asset. For example, it may be preferred to capture inventory and condition information on a sampling basis for some assets, and to complete a 100 percent survey on others. The frequency of the updates may also vary. For example, in some cases, annual or biannual data may be required. In others, ADOT may wish to extend the updates to a longer cycle.

3. Define the data needs for each priority asset, and determine the best way to collect and maintain the data.

4. Starting with highest priority, implement the approaches defined in steps 2 and 3.

Timing: 6 months for steps 1, 2, and 3; 24 months for step 4.

Preliminary Cost Estimate: Internal/consultant (low) for steps 1, 2, and 3; internal/consultant (high) for step 4.

5.2 SUMMARY

Table 5.1 summarizes the initiatives described above. It also documents estimated start and end dates for each initiative. Taken collectively, these initiatives would enable ADOT to make significant improvements to its asset management program over the next couple of years.

Table 5.1   Implementation Summary

#	Initiative	Preliminary Cost Estimate	Timing (months)	Scheduling Notes
1	Develop a TAM Strategic Plan	Low	2	This should be the first activity
2	Analyze Asset Management Constraints	Medium	6	
3	Develop Initial Transportation Asset Management Plan	High	13	
4	Improve Data Access, Sharing and Mapping	High	24	
5	Enhance the Ability to Analyze Pavements and Bridges	High	12	These capabilities will support Initiative 3
6	Improve Coordination between the Maintenance and Capital Programs	Low	12	Part of this initiative is ongoing
7	Incorporate Performance into the Budgeting Process	Indirect	12	Part of this initiative is ongoing
8	Integrate Risk Management into the Asset Management Process	Medium	6	Part of this initiative is ongoing
9	Expand TAM Practices to Assets Beyond Bridges and Pavements	High	24	