**Project No. 08-115**

# Executive Summary:

# Guidebook for Data and Information Systems for Transportation Asset Management

**FINAL GUIDEBOOK EXECUTIVE SUMMARY**

**Prepared for**

**National Cooperative Highway Research Program**

**Transportation Research Board**

**of**

**The National Academies of Sciences, Engineering, and Medicine**

**Frances Harrison**
**William Duke**
**Spy Pond Partners, LLC.**
**Arlington, Massachusetts**

**Donna Huey**
**Christopher Harman**
**Atkins North America, Inc.**
**Orlando, Florida**

***ACKNOWLEDGMENT OF SPONSORSHIP***

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# Transportation Asset Management (TAM) is by nature data and analysis intensive.

# Is your agency effectively using data and information systems to support its TAM program?



## TAM Data Needs

Asset Inventory

Asset Condition & Performance

Location Referencing

Design Standards

Maintenance and Project Information

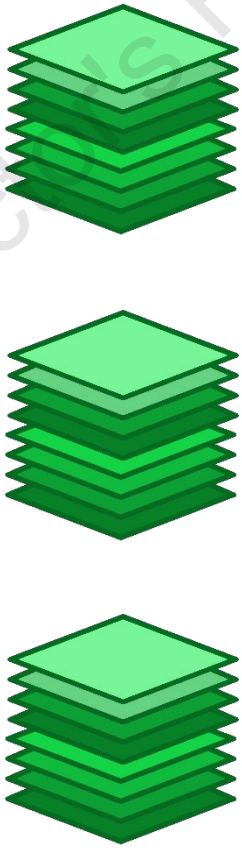
Agency Financials

Demand Forecasts

Environmental Data

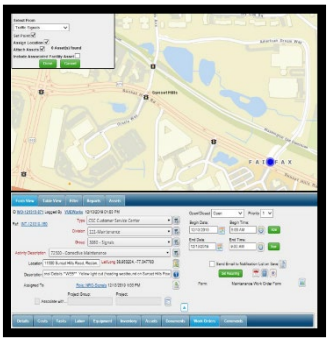
Decision-Maker Priorities

Public Perception



## TAM Data Uses

Optimize Maintenance, Rehabilitation, and Improvement Strategies

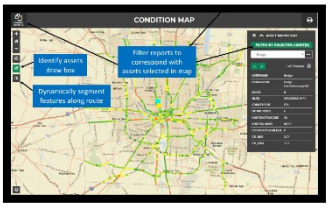


Prioritize TAM Resource Allocation

Support Agency Planning and Programming


Report Condition, Performance, and Accomplishments

Ensure Decision-Making Accountability and Transparency



# Most DOTs have asset management systems in place, but face challenges and seek to capitalize on new tools and technologies.

## This Guidebook provides a structured approach to assess current practices and improve use of data and information for TAM.

This approach can be applied in a comprehensive fashion; it can be targeted for a particular asset; or it can focus on a particular topic area – such as data collection or data integration.

A companion digital tool – the TAM Data Assistant – is available for conducting the assessment, identifying and evaluating candidate improvements, and summarizing and communicating outcomes for implementation.

Supplemental resources help agencies with each step of the process – understanding the context for each of the assessment elements, learning about and evaluating possible improvements, and planning an implementation strategy.

**Key aspects of the methodology are highlighted on the following pages.**

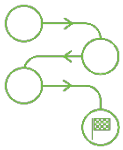
# Guidebook Methodology Overview

**Guidebook Purpose and Scope.** Advance DOT data and information systems for Transportation Asset Management (TAM) through benchmarking, improvement identification, and improvement evaluation.

**Online TAM Data Assistant Tool.** Complete a guided workflow through an online digital tool to carry out the recommended process. Capture and record results within the tool, which also provides useful summary and communication materials and allows details to be exported whenever needed.


**Guidebook Technical Framework.** Focus assessment activities using the guidebook's comprehensive data life-cycle framework, organized around five steps for effective specification, gathering, and use of data and information for TAM.

**Detailed Practice Benchmarking.** Evaluate the current and desired state of agency practice against element-level practice benchmarks, identifying practice gaps for improvement.



**Improvement Identification.** Select from potential improvements, specific to previously identified practice gaps. The Guidebook's pre-defined improvements offer a clear set of action steps to improve the agency TAM program to the desired state.

**Improvement Evaluation.** Analyze selected improvements to identify and document investment priorities. Characterize individual improvement impacts, efforts, and potential organizational challenges.

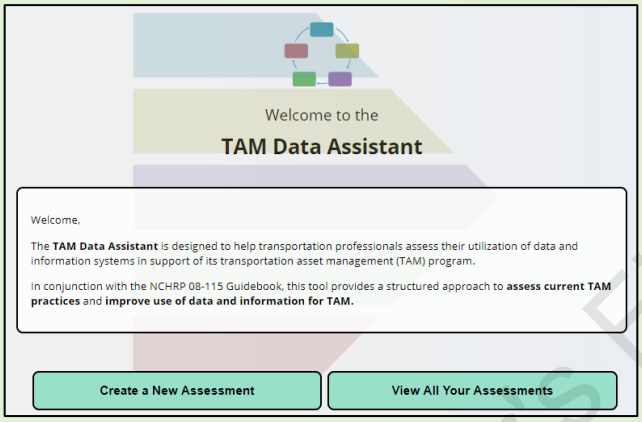
**Executive Communication.** Summarize detailed self-assessment and improvement results using automatically generated communication materials describing assessment outcomes. Use these materials to effectively communicate with executive-level decision-makers and secure implementation funding and resources.

**Implementation Support.** Case studies provide real world context useful for DOT scoping, resourcing, and execution of improvement efforts. Additionally, organizational practices are documented, providing guidance helpful to DOTs needing to overcome institutional challenges relating to implementation.

# TAM Data Assistant

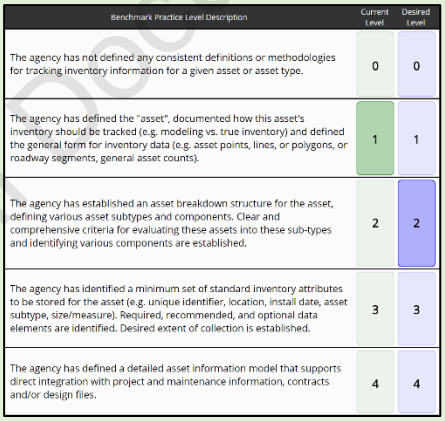
A companion online digital tool is available through the AASHTO TAM Portal at: [www.dataassessment.tam-portal.com](http://www.dataassessment.tam-portal.com).

## Create Assessments



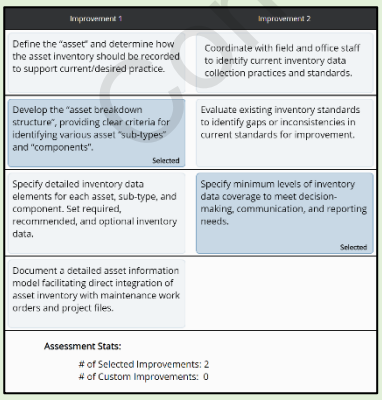

Create and customize assessments of your TAM programs.

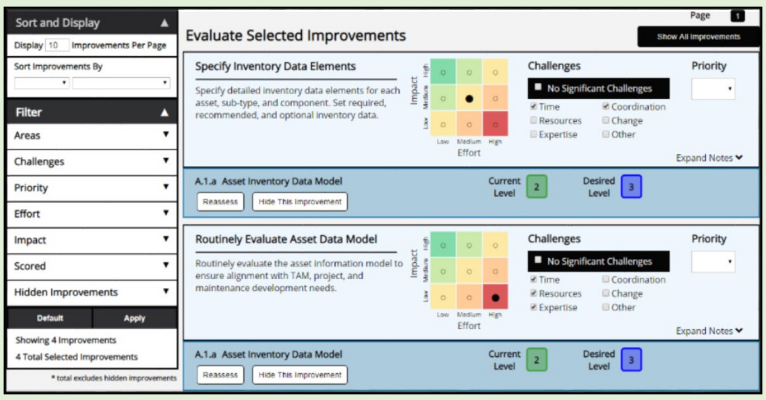
## Benchmark Performance




Benchmark current practices and desired state for 51 individual elements.

## Select, Evaluate, and Prioritize Improvements

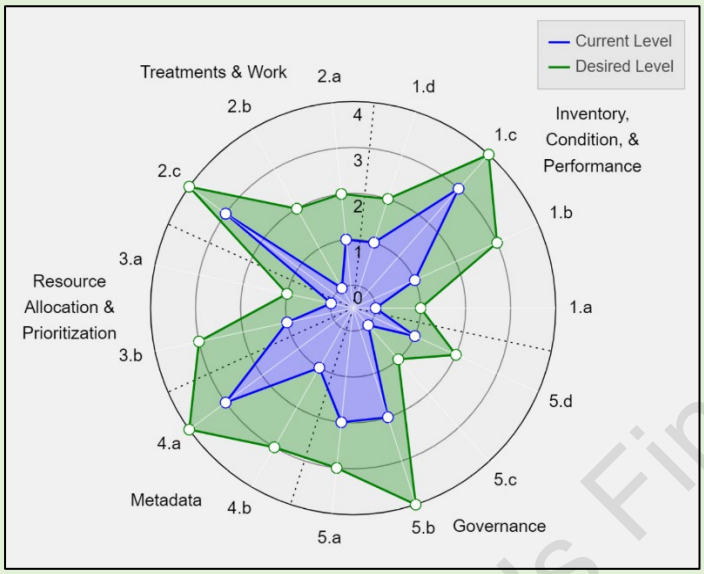


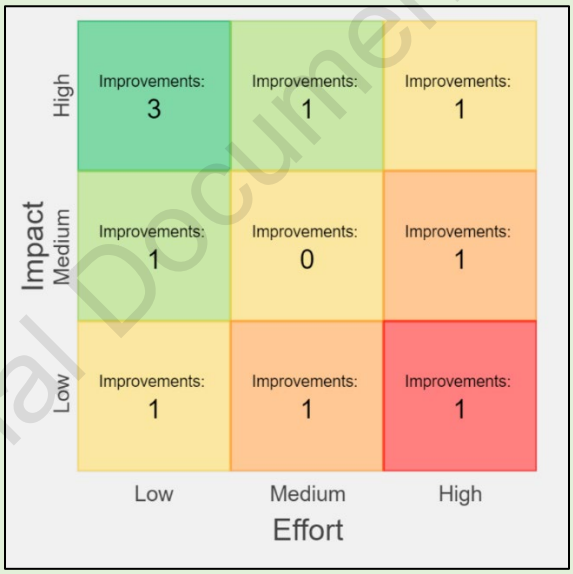



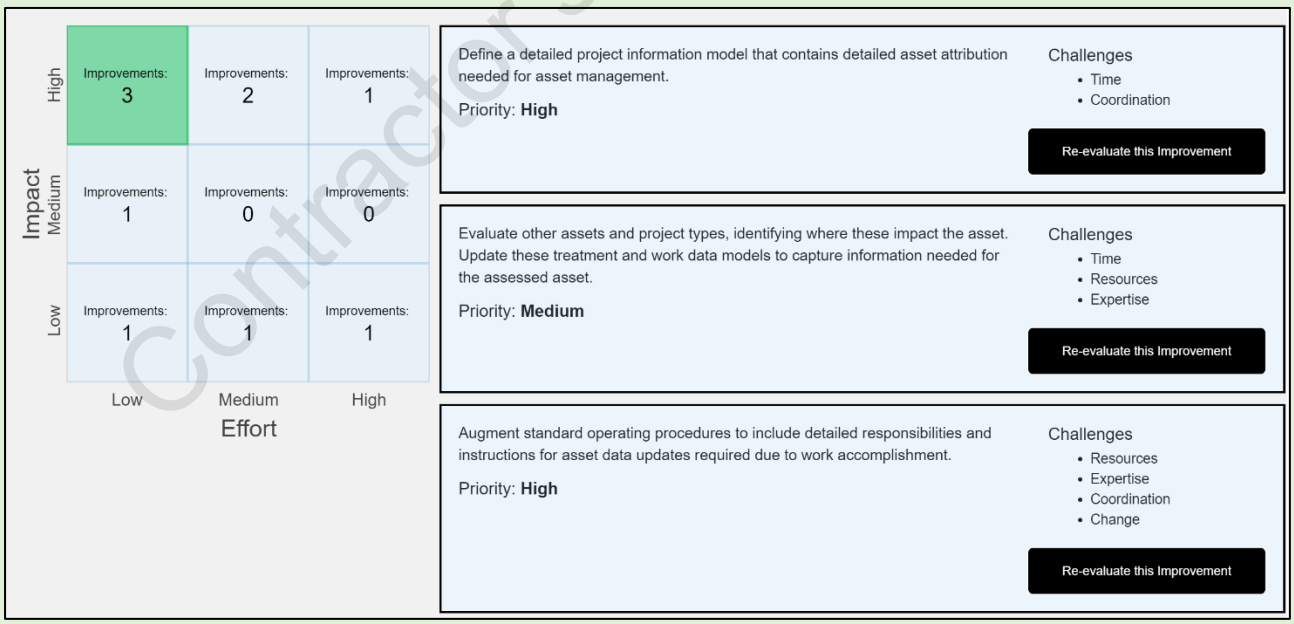

Select from candidate improvements to address identified practice gaps. Prioritize selected improvement based on implementation impact, effort, and challenges.

# TAM Data Assistant (continued)

## Summarize and Communicate Outcomes




Export summary communication materials, directly from the tool, to engage executives, advocate for implementation priorities, and frame decision-making.

# Guidebook Technical Framework

## Organized around five essential steps to making efficient and effective use of data and information for TAM.

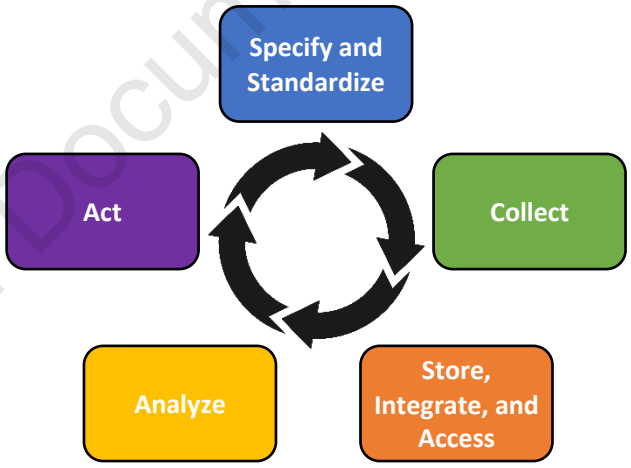
**Specify and Standardize Data** – Establish asset, treatment, and work data standards; prioritization factors; metadata standards; and governance programs.

**Collect Data** – Address coverage, automation, and collection of data for incorporation into the TAM program.

**Store, Integrate, and Access Data** – Structure, integrate, and provide access to data to support TAM operations, management and reporting needs.

**Analyze Data** – Establish decision-support tools, techniques, and practices to develop actionable information and insights.

**Act Informed by Data** – Apply data and information systems, processes, tools, and techniques to TAM decision-making.




| A. Specify and Standardize | | |
|---|---|---|
| A.1 Inventory, Condition and Performance Standards | A.1.a | Asset Inventory Data Model |
| | A.1.b | Asset Condition and/or Performance Data Model |
| | A.1.c | Design Model Standards |
| | A.1.d | Location Referencing |
| A.2 Treatments and Work Standards | A.2.a | Treatment and Work Data Model |
| | A.2.b | Treatment and Work Location Referencing |
| | A.2.c | Process Documentation and Management |
| A.3 Resource Allocation and Prioritization | A.3.a | Prioritization Factors |
| | A.3.b | Analysis Parameters |
| A.4 Metadata | A.4.a | Data Dictionary Standards and Guidelines |
| | A.4.b | Dataset Metadata Standards and Guidelines |
| A.5 Governance | A.5.a | Data Stewardship |
| | A.5.b | Data Standards & Guidelines Development / Adoption Processes |
| | A.5.c | Data Collection Approval / Coordination Practices |
| | A.5.d | Change Control (Systems and Data) Processes |

| B. Collect | | |
|---|---|---|
| B.1 Inventory, Condition, and Performance Collection | B.1.a | Inventory, Condition, & Performance Coverage |
| | B.1.b | Inventory, Condition, & Performance Automation |
| | B.1.c | Inventory, Condition, & Performance Quality |
| B.2 Project Information Collection | B.2.a | Project Information Coverage |
| | B.2.b | Project Information Automation |
| | B.2.c | Project Information Quality |
| B.3 Maintenance Information Collection | B.3.a | Maintenance Information Coverage |
| | B.3.b | Maintenance Information Automation |
| | B.3.c | Maintenance Information Quality |
| B.4 Priority Criteria and Values Collection | B.4.a | Public Perception |
| | B.4.b | Decision Maker Values |

| C. Store, Integrate, and Access | | |
|---|---|---|
| C.1 Databases | C.1.a | Efficient Storage |
| | C.1.b | Database Linkages |
| | C.1.c | Document Linkages |
| | C.1.d | Data Storage Capacity |
| C.2 Asset Life-Cycle Data Integration Workflows | C.2.a | Asset Management Data to Project or Work Order |
| | C.2.b | Project Planning to Project Development |
| | C.2.c | Project Development to Project Delivery |
| | C.2.d | Project Delivery to Asset Management Data |
| C.3 Other Data Integration Workflows | C.3.a | Revenue, Budget, and Expenditure Data |
| | C.3.b | Demand and/or Utilization Data |
| | C.3.c | Environmental Data |
| C.4 Data Access | C.4.a | Field Access to Data |
| | C.4.b | Public Access to Data |
| | C.4.c | Access Security |

| D. Analyze | | |
|---|---|---|
| D.1 Data Exploration, Reporting, and Visualization | D.1.a | Analysis Environment |
| | D.1.b | Analysis Practices |
| | D.1.c | Analysis Tools |
| D.2 Modeling | D.2.a | Asset Performance Prediction |
| | D.2.b | Optimization / Prioritization |

| E. Act | | |
|---|---|---|
| E.1 Resource Allocation and Prioritization | E.1.a | Performance Targeting |
| | E.1.b | Project Prioritization |
| E.2 Project Planning, Scoping, and Design | E.2.a | Data-Driven Project Planning and Scoping |
| | E.2.b | Data-Driven Project Design |
| E.3 Maintenance | E.3.a | Infrastructure Maintenance |
| | E.3.b | Equipment Maintenance |

# Detailed Practice Benchmarking

## Evaluate the current and desired state of DOT practice against element-level practice benchmarks, identifying practice gaps for improvement.

**Select current and desired practice levels** from detailed, element-specific practice benchmarks.

**Utilize Guidebook materials** to help understand the scope of practice in each portion of the assessment.

- **Identify key issues and decisions** to be made when establishing a desired state and selecting improvements.
- **Review conceptual examples** to develop a firm understanding of agency practice.

**Benchmark Levels**

**General Practice Level Descriptions**

0 **Non-Existent:** The DOT does not have any significant practices within this aspect of their business.

1 **Initial Steps:** DOT practices are found, however these are characterized by ad-hoc or informal application and are not likely to be endorsed by management.

2 **Incremental Improvement:** The DOT is beginning to see formalization of the processes and structures within this aspect of their business.

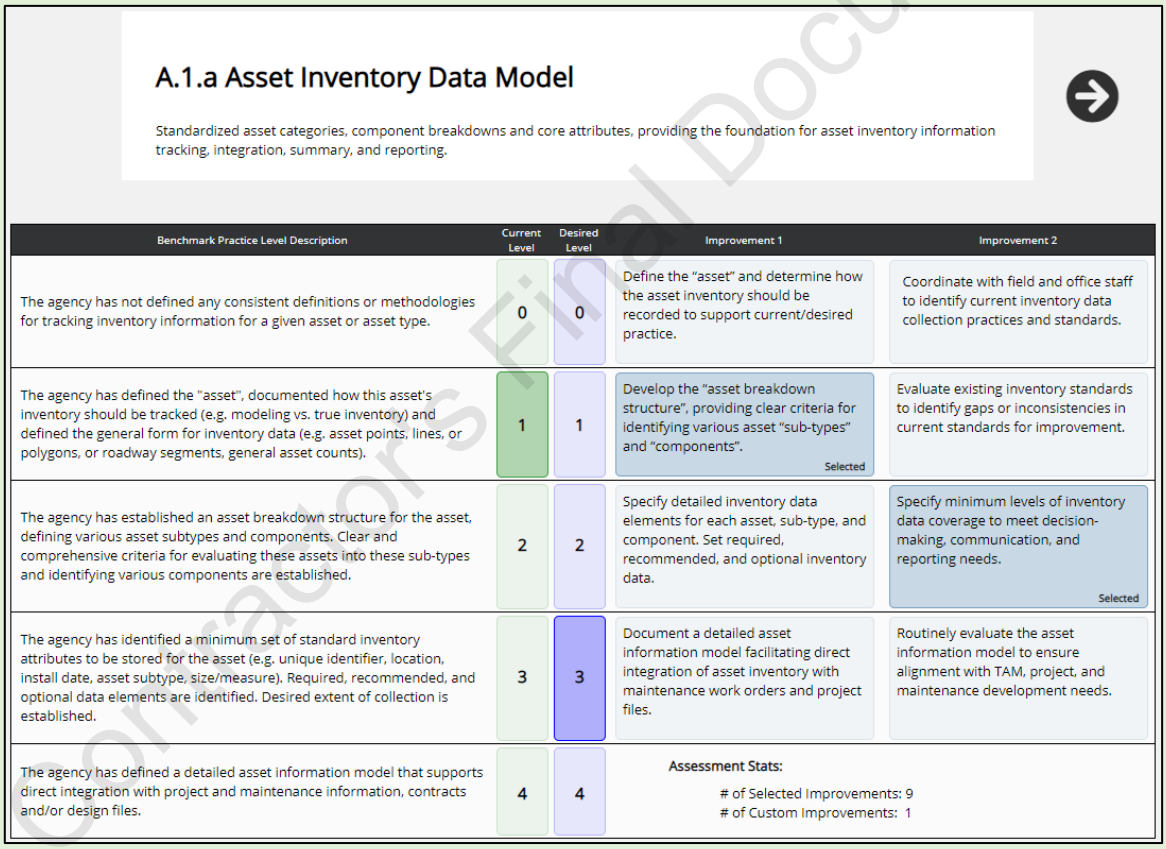
3 **Advanced Practice:** The DOT is performing at or above the standard of their peers.

4 **Top Performing:** The DOT is a leading example of practice amongst their peers.

# Improvement Identification

## Select potential improvements, specific to DOT identified practice gaps.

### Improvement Identification using the TAM Data Assistant

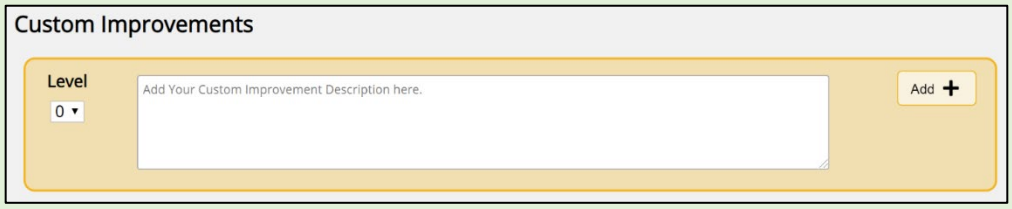


A.1.a Asset Inventory Data Model

Standardized asset categories, component breakdowns and core attributes, providing the foundation for asset inventory information tracking, integration, summary, and reporting.

| Benchmark Practice Level Description | Current Level | Desired Level | Improvement 1 | Improvement 2 |
|---|---|---|---|---|
| The agency has not defined any consistent definitions or methodologies for tracking inventory information for a given asset or asset type. | 0 | 0 | Define the "asset" and determine how the asset inventory should be recorded to support current/desired practice. | Coordinate with field and office staff to identify current inventory data collection practices and standards. |
| The agency has defined the "asset", documented how this asset's inventory should be tracked (e.g. modeling vs. true inventory) and defined the general form for inventory data (e.g. asset points, lines, or polygons, or roadway segments, general asset counts). | 1 | 1 | Develop the "asset breakdown structure", providing clear criteria for identifying various asset "sub-types" and "components". Selected | Evaluate existing inventory standards to identify gaps or inconsistencies in current standards for improvement. |
| The agency has established an asset breakdown structure for the asset, defining various asset subtypes and components. Clear and comprehensive criteria for evaluating these assets into these sub-types and identifying various components are established. | 2 | 2 | Specify detailed inventory data elements for each asset, sub-type, and component. Set required, recommended, and optional inventory data. | Specify minimum levels of inventory data coverage to meet decision-making, communication, and reporting needs. Selected |
| The agency has identified a minimum set of standard inventory attributes to be stored for the asset (e.g. unique identifier, location, install date, asset subtype, size/measure). Required, recommended, and optional data elements are identified. Desired extent of collection is established. | 3 | 3 | Document a detailed asset information model facilitating direct integration of asset inventory with maintenance work orders and project files. | Routinely evaluate the asset information model to ensure alignment with TAM, project, and maintenance development needs. |
| The agency has defined a detailed asset information model that supports direct integration with project and maintenance information, contracts and/or design files. | 4 | 4 | **Assessment Stats:** # of Selected Improvements: 9 # of Custom Improvements: 1 | |

Pre-defined improvements offer a clear set of action steps to reach the desired state.

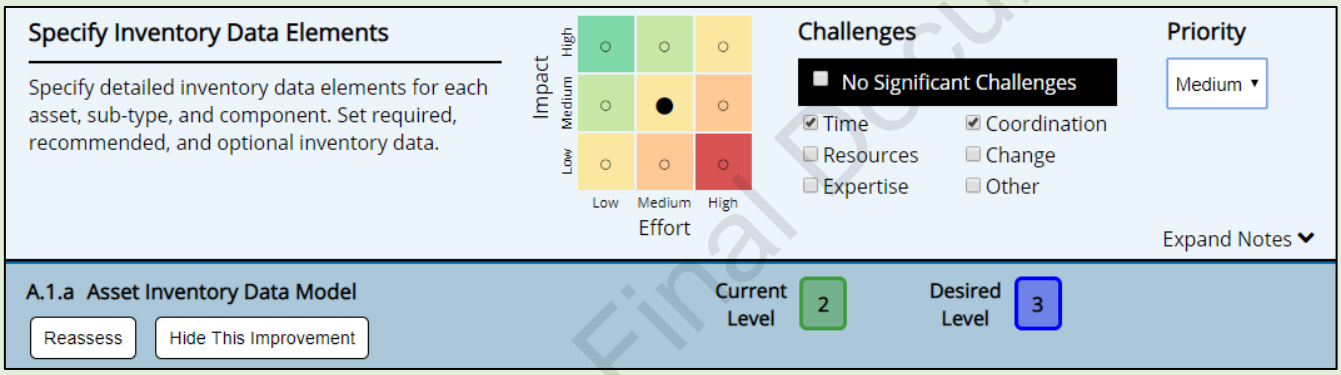



Add, track, and report custom improvements specific to your agency.

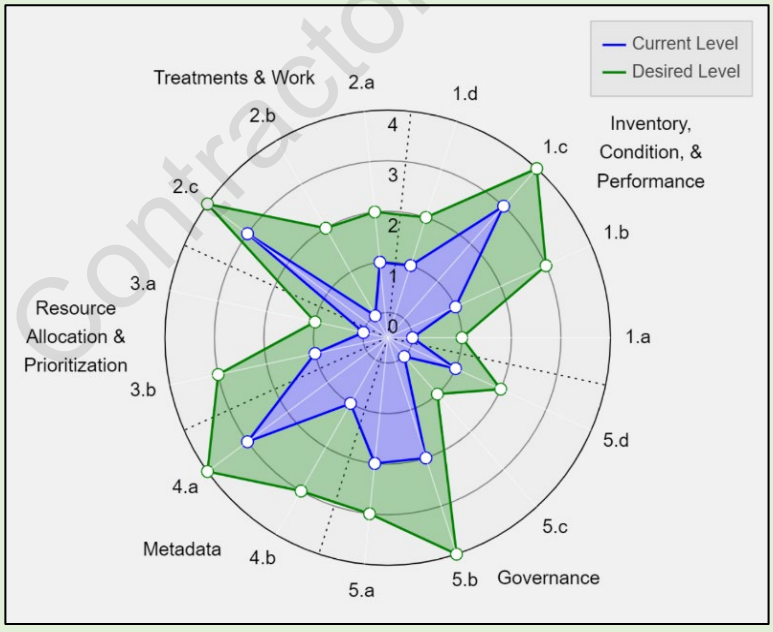
# Improvement Evaluation

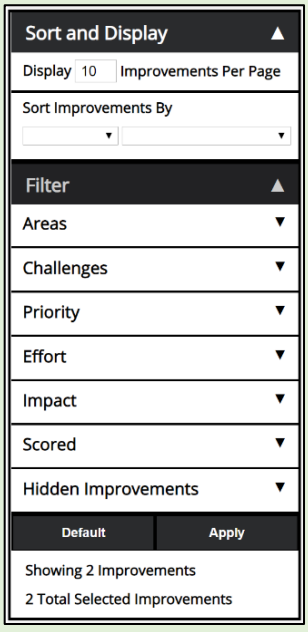
## Establish investment priorities based on implementation impact and effort, and in consideration of identified organizational challenges.

### Improvement Evaluation using the TAM Data Assistant




Establish priorities and support future implementation through examination of the relative impact, effort, and potential organizational challenges.




Consider identified practice gaps and apply filter and sorting criteria to as needed to facilitate evaluation.

# Executive Communication

## Develop clear, concise communication of current practices, desired state, key performance gaps, and priority improvements.

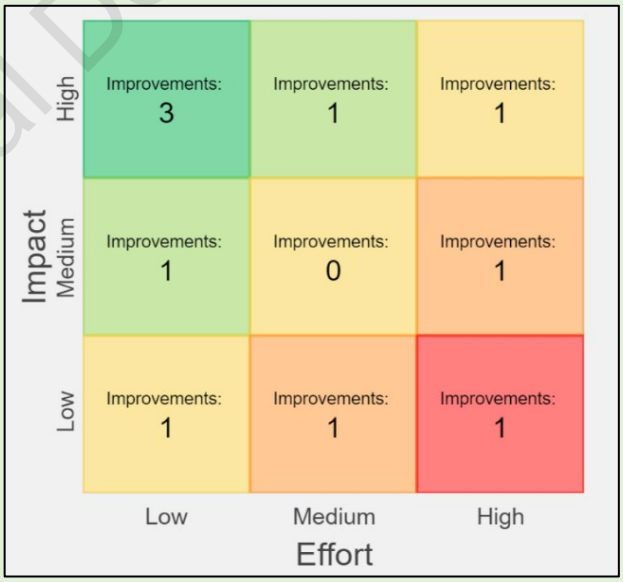
1. **Present the assessment focus and context** emphasizing the motivation, desired value in selecting the focus, and the cross-functional nature of the assessment team.

2. **Communicate current and desired state** quickly demonstrating where performance is low, where it is high, and where improvement is most necessary. Provide practical examples of impacts that low performance is having on current TAM business.

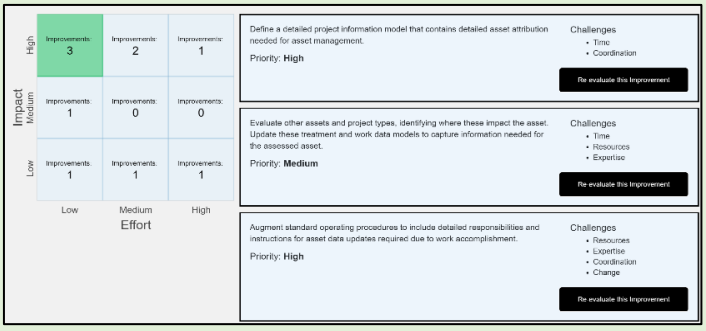
3. **Share a clear set of implementation priorities** that address gaps in current practices. Emphasize these are the agreed upon priorities of the cross-functional team.

4. **Acknowledge challenges** that will be faced and outline organizational practices and real world case studies that will support successful implementation.

### Review and Communicate Selected Improvements




Present selected improvements by relative impact and effort




Review improvement and evaluation details as needed.

# Implementation Support

**Making meaningful changes to how data are managed, shared, and used within and across a DOT TAM program requires much more than procuring new tools and technologies.**

## Organizational Practices

| Strategic Management | Talent Management | Initiative Management | Knowledge Management |
|---|---|---|---|

Overcome institutional challenges through deliberate application of identified organizational practices.

## Case Studies

**Ohio DOT: TAM Decision Support Tool Case Study**

Act Informed by Data
Project Planning, Scoping, and Design

The Ohio DOT developed a Transportation Asset Management Decision Support Tool to provide a mechanism for ODOT managers to make decisions on adequate information for optimizing the performance and cost-effectiveness of infrastructure assets.

This tool supports investment decisions and demonstrates the return on those investments both quantitatively and qualitatively.

The tool was developed and implemented through the following approach:

**Step 1: User Needs and Use Case Documentation**
User needs and use cases for the proposed decision support tool were developed by a cross-functional team. Recommendations were provided through 1) a series of workshops with individual business and data subject matter experts, 2) engagement of executive management to establish decision-making values and priorities, and 3) review of tools of peer agencies.

**Step 2: Develop Data Sources**
Enterprise data needs were identified and associated reference and master data sets were developed from source systems.

**Step 3: Configure Off-the-Shelf Business Intelligence Tools**
Requirements for a configurable, off-the-shelf solution were developed to ensure long-term sustainability. A custom solution was identified as a risk.

**Step 4: User Engagement and Training**
Staff were allowed dedicated time away from routine business responsibilities. An agile approach was used for delivery.

**Step 5: Data Quality Improvement**
Integrating data and formalizing metrics exposed data quality issues. Resources and responsibilities for quality were assigned.

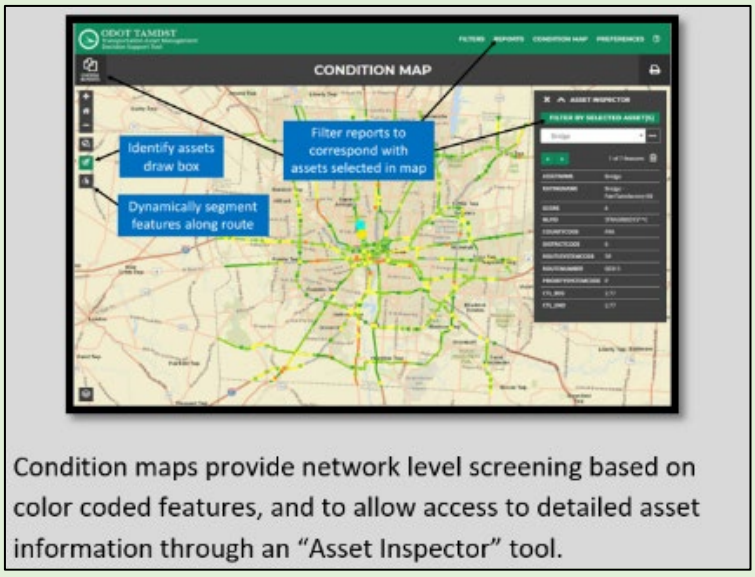
**Value Delivered**
Centralized portal for data access

**Leadership**
Executive endorsement and vision from onset

**Expertise**
Business Engagement
Data Architecture & Management
BI Software & Dashboards

**Coordination**
Cross-functional teams & training
Central office, field, and support staff

**Change**
Impacts to Roles and Responsibilities
Accountability for data-informed decisions
Data Issues Exposed




Condition maps provide network level screening based on color coded features, and to allow access to detailed asset information through an "Asset Inspector" tool.

Selected case studies provide real world models useful for DOT scoping, resourcing, and execution of improvement efforts.