

Summary of Final Report for TMC PFS Project:

Performance Measures and Health Index of Intelligent Transportation Systems Assets

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Dan Lukasik, Parsons

Purpose and Objectives

Purpose:

- Synthesize agency practices with managing traffic management systems assets and resources.

Objectives:

- Identify what assets agency may be managing.
- Discuss data and analyses methods applicable for identifying conditions of specific assets.
- Explore activities, resources and methods agencies pursue to establish, conduct and sustain asset management activities for intelligent transportation systems (ITS) devices.
- Explore how the results of asset management initiatives for ITS devices could be integrated with a TSMO Plan, Transportation Asset Management Plans (TAMPs), or other agency or regional strategic plans.



Asset Management Definition

Strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both 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 life cycle of the assets at minimal practical cost (23 CFR § 515.5).

Literature Summary

- 24 State departments of transportation (DOTs) and other agencies were contacted or websites reviewed.
 - TMC PFS member states.
 - Other State DOTs.
 - Other agencies.
- Conducted phone interviews with selected agencies.
- 44 documents/resources identified.

Components of ITS Asset Management Plans

- Goals for asset management initiatives or actions.
- State or local agency performance measures for condition of ITS Assets.
- Assets identified for tracking and monitoring.
 - Attributes to measure and report asset conditions.
 - Data collection frequency.



ITS Assets in Transportation Asset Management Plans

State – Plan (Year)	ITS Asset Classes Included	Condition	Performance Targets	Lifecycle Costs	Risk Analysis	Funding
Alaska – Asset Management Synthesis for the Parks Highway Corridor (2012)	<ul style="list-style-type: none"> Field Devices 	Y	N	N	N	N
California TAMP (2017/2018)	<ul style="list-style-type: none"> Field Devices 	Y	N	N	N	N
Colorado Risk Based Asset Management Plan (2019)	<ul style="list-style-type: none"> Field Devices Communications 	Y	Y	Y	Y	Y
Connecticut TAMP (2019)	<ul style="list-style-type: none"> Field Devices 	Y	Y	N	N	N
Georgia TAMP (2019)	<ul style="list-style-type: none"> Field Devices Communications and Networking Hardware 	N	N	N	N	N

Examples of ITS Asset Management Goals and Objectives

ITS Asset Management Goals	ITS Asset Management Objectives
<ul style="list-style-type: none"> • Maximize the reliability, efficiency, and lifecycle costs of ITS assets. • Ensure the effective operation of TMSs. 	<ul style="list-style-type: none"> • Maintain a greater than 90 percent uptime for all critical Tier 1 ITS assets (e.g., traffic detectors, traffic signals, communications devices, message signs, etc.). • Maintain a greater than 70 percent update for non-critical ITS assets (e.g. weather stations, highway advisory radios, etc.). • 90 percent of ITS assets will operate with 90 percent of their life expectancy. • Implement a solution to measure ITS asset performance in real-time or near-real-time. • Develop an ITS asset performance measurement data analytics platform. • Establish an ITS asset maintenance program with service level agreements).

Examples of Asset Management Roles and Permissions

Roles	Permissions
Asset Management Data Entry Personnel	Adding, editing, and searching assets in ITS asset management database
Operators	Create ITS maintenance tickets, view tickets, close tickets, and view and review work orders
Field Maintenance Personnel	View tickets, update ticket progress, advance tickets, close tickets, and issue work orders
Inspectors	Review field tests and field test results; update work orders
IT Administrators	Maintain asset management systems, services, network management systems, and data analytics tools
TMC and Operations Managers	Review asset performance reports
Contracts Personnel	Establish contracts for ITS system asset management
Asset Management Contractor	Maintain ITS field elements and communications, respond to and complete trouble tickets, and perform field testing
TMS Software/Systems Integration Contractor (s)	Maintain central software and hardware components, respond to and complete trouble tickets, and perform systems testing

NYDOT Asset Management Roles and Permissions

TAM System: Roles & Permissions											
Permissions	Roles*										
	Data Entry Operator	Data Entry Manager	Data Entry Guest	Operator	Reviewer	Central	Field	TES Review	Inspector	EIC	Administrator
Add Assets	•	•									•
Edit Asset Data	•	•									•
View/Search Assets	•	•	•								•
Create New Ticket (send to Reviewer for Issue)				•							•
Issue Tickets					•			•			•
View Tickets				•	•	•	•	•			•
Update ticket progress						•	•	•			•
Move Ticket to next phase						•	•	•			•
Move Ticket to any phase						•	•	•			•
Request Ticket Closure						•	•	•			•
Close Ticket				•	•						•
Issue Work Order								•			•
View Work Order				•	•	•	•	•	•	•	•
Update Work Order progress								•	•	•	•
Retract Work Order								•			•
Reissue Work Order								•			•
Hold Work Order								•	•	•	•
Forward Work Order to Contractor								•	•	•	•
Request to Close Work Order								•	•		•
Close Work Order								•		•	•
Add users											•
Edit users											•
Assign users to roles											•

* A user can be assigned to more than one role. For example: a user can be assigned a Reviewer role as well as a Data Entry Manager role. The user will then have the permissions applicable to Reviewer and Data Entry Manager roles.

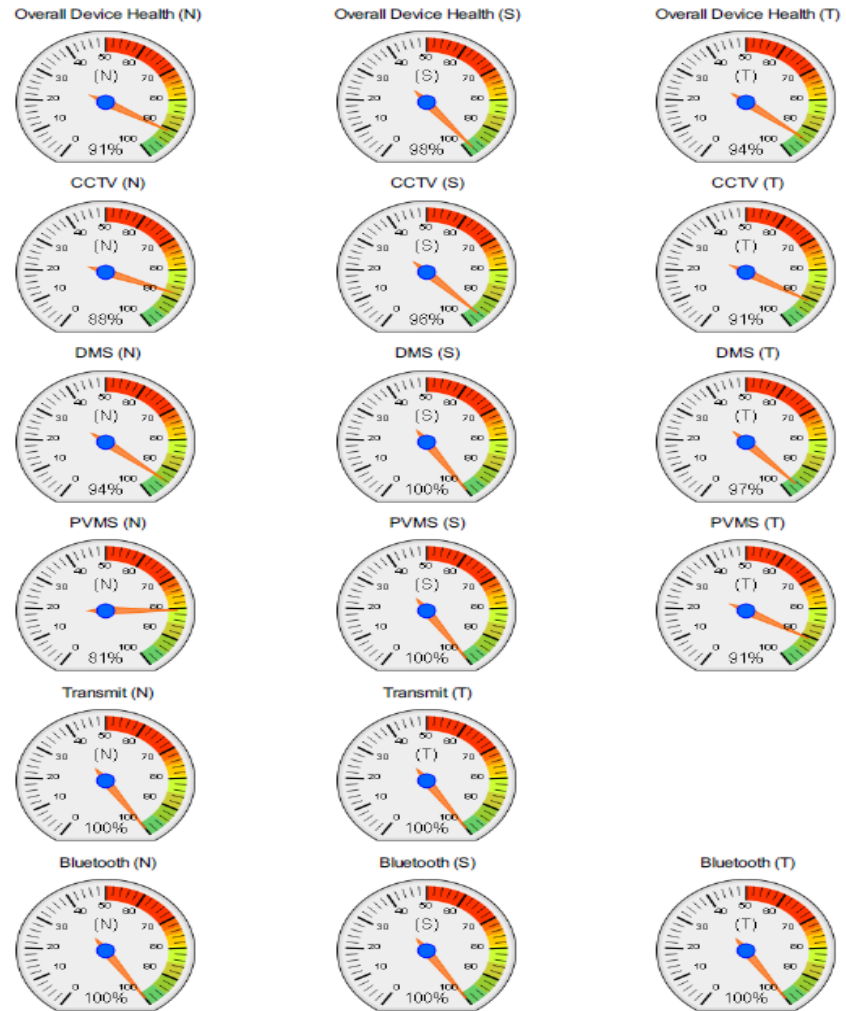
Source: New York State Department of Transportation

State Or Local Agency Performance Measure Examples for ITS Assets

- **Asset condition (e.g., good, medium, poor)** – Calculated by comparing the age of a device against the manufacturer’s recommended service life.
- **Asset health/uptime/reliability** - Amount of time the equipment/system was malfunctioning compared to the total amount of operational time.
- **Mean time between failure** – This is the predicted elapsed time between inherent failures.
- **Mean time to repair** – This is the basic measure of the maintainability of repairable items.
- **Malfunction/issue type** – When there is a device malfunction or failure, it can be beneficial to record the type of issue that is observed.
- **Lifecycle costs, or whole-life costing** – How much money will be spent on an asset over the course of its useful life.



Asset Management Dashboards



Source: New Jersey Department of Transportation

Considerations for Creating an ITS Asset Management Plan

Key Questions/Issues

- Which assets are most important?
- What asset management activities should be considered for the different types of assets, e.g. inventorying?
- What are the key items to consider when assessing ITS asset importance and placing them in “tiers”?

ITS Asset Management Activities

- Centralize ITS asset information.
- Create device tiers to prioritize attention.
- Establish ITS asset management contracts.
- Develop data management plan.
- Develop asset management plan.
- Perform life cycle planning.
- Install asset management tools (NMS, MOMS, Trouble Ticket).
- Develop obsolescence plans.



Framework for ITS Asset Tiers

ITS Assets can be assigned into tiers, the highest tier assets have the most value in terms of prioritized attention.

- Tier 1:
 - Asset is critical to operations.
 - Minimal downtime should be allowed.
 - Measurement targets should be identified and tracked in real-time.
 - Should receive dedicated prioritized funding.
- Tier 2:
 - Asset is highly beneficial to system operations.
 - Device should be repaired within reasonable timeframes.
 - Measurement targets should be identified and tracked.
- Tier 3:
 - Asset is beneficial but not critical to system operations.
 - Item should be repaired or replaced when damaged or demonstrated degraded performance.



Example of ITS Asset Tiers

Tier 1	Tier 2	Tier 3
<ul style="list-style-type: none">• ATMS servers.• Database servers.• Communication servers.• Advanced Traveler Information Servers.• ATMS software.• Primary communication media and hardware• ITS field devices, e.g. DMS	<ul style="list-style-type: none">• CCTV surveillance cameras.• Road weather information systems.• Secondary communication media (e.g., branch fibers).• Video wall controllers.• Video monitors/projection units.• ATMS workstations.	<ul style="list-style-type: none">• Highway advisory radio.• Weigh in motion.• Emergency call boxes.• Portable signs.• Portable detectors.• Portable cameras.



Develop a Data Management Plan

Data Attribute	Description
Data Collection/Storage	Standardize the collection of ITS device data throughout the agency so the development of the visualizations will be easier.
Data Archive	Provides for historical information that would otherwise not be available. Archived data can help with before/after studies or provide analysis over a longer period of time.
Data Accuracy/Completeness	To be able to generate meaningful performance measurement data, it is important that the data collected be accurate and complete.
Reporting/Dissemination	Information generated will need to be put in a meaningful report and disseminated regularly. Determine the frequency of the reporting, what needs to be disseminated, and who the audience is.



Asset Type and Information for Data Management Plan

Asset	Attributes	Example of Frequency Collection
TMS Database Communication Advanced Traveler Information System	Device Make and Model	Update once per year
	System Up/Down	Once every 15 min
	Central Processing Unit Metrics (utilization, ready, used, wait)	Once every 15 min
	Memory Metrics (utilization, overhead, shared, usage, swap-out and swap-in)	Once every 15 min
	Network Metrics (packets received/packets transmitted)	Once every 15 min
	Disk Metrics (utilization, free, read/write rate, read/write requests)	Once per hour
	Temperature	Once every 15 min
	Fan Speed	Once every 15 min
	Power Supply	Once every 15 min
	Processor Clock Speed	Once every 15 min
	Battery	Once per hour
	Disk Array	Once per hour



Asset Management in Operations

The screenshot shows a software window titled "FAILURE MANAGEMENT" with three tabs: "PHASE 1", "SWARM Phase 2", and "Congestion Phase 2". The "SWARM Phase 2" tab is selected. The interface is divided into two main sections: "Segment Travel Time Calculations" and "Section Travel Time Calculations".

Segment Travel Time Calculations:
Where a VDS has missing data, data from the nearest "good" upstream VDS and the nearest "good" downstream VDS will be used to estimate a speed for the "bad" VDS, provided that the maximum span distance between the "good" VDSs does not exceed: (0.0 - 6.0) miles

Section Travel Time Calculations:
Travel time calculations are not available if the contiguous distance within a section with "bad" or missing data equals or exceeds: (0.5 - 10.0) miles
Travel time calculations are not available if the ratio of "good" segment lengths to overall section length is less than: (0.1 - 0.9)

At the bottom of the window, there are three buttons: "Revert", "Save", and "Dismiss". A red rectangular box highlights the "Section Travel Time Calculations" section, and a red arrow points from this box to a text box on the right.

Agencies must have real-time asset health to operate correctly, e.g. in order to estimate travel times, the algorithm must know which vehicle detectors are operational over the measured segment.

Source: California Department of Transportation District 7, ATMS, Travel Time User's Guide

Asset Management in Operations

Asset management rules regarding ITS asset health should be incorporated directly into the TMS application.

This example is specific to vehicle speed/detector sensor health and how the asset management parameters can be adjusted.

The screenshot shows a software window titled "FAILURE MANAGEMENT" with a menu bar containing "File" and "Edit". Below the menu bar are two tabs: "PHASE 1" and "SWARM Phase 2". The main content area contains four adjustable parameters, each with a text description and a numeric input field followed by a unit:

- Number of consecutive periods a detector in the "hard failed" status must pass its threshold test to be reclassified as "ok". periods
- Number of consecutive periods a detector in the "soft failed" status must fail its threshold test to be reclassified "hard failed". periods
- Number of total periods in a day a detector has failed a threshold test to be reclassified "hard failed". periods
- Fraction of good data necessary in each detector class to allow failure management to proceed with standard analysis (otherwise uses "Not Enough Good Data" thresholds for analysis). (0-1)

At the bottom of the main content area are three buttons: "Occupancy Thresholds", "Volume Thresholds", and "State Change Counters". At the very bottom of the window are three buttons: "Revert", "Save", and "Dismiss". A red rectangular box highlights the four adjustable parameters.

Source: California Department of Transportation District 7 ATMS, Maintenance Manual



U.S. Department of Transportation

Federal Highway Administration TMC Pooled Fund Study

Asset Management in Operations

To develop accurate response plans, the real-time asset availability should be known in real time.

Asset management functions can be incorporated directly into TMS solutions

Corridor | Global | **Asset Availability** | Strategy Matrix | Tim Q | Corridor Score | Transit | RP Expiration Ti

Minimum Action Plan Runtimes: 22 min

Global Arterial Availability Thresholds

Arterial Routes	% of Routes Congested	Arterial Signals	% of Asset Operational
Aggressive	90 %	Aggressive	60 %
Moderate	80 %	Moderate	75 %
Conservative	70 %	Conservative	100 %
Minimum # of Links	2	Minimum # of Signals	5

Route Specific Override Arterial Availability Thresholds

Route: I-15

Arterial Routes	% of Routes Congested	Arterial Signals	% of Asset Operational
Aggressive	90	Aggressive	60
Moderate	80	Moderate	75
Conservative	70	Conservative	100
Minimum # of Links	2	Minimum # of Signals	5

Save Cancel

Source: San Diego Association of Governments, Interstate 15 integrated corridor management system.



Practices - Processes and Strategies

- Establish goals for ITS asset management plans and efforts.
- Establish State or local agency performance measures, targets and ITS data sources.
- Inventory all ITS assets.
- Assess condition of assets.
- Establish ITS asset management contracts.
- Install ITS asset management tools (NMS, MOMS, Trouble Ticket).



Practices - Processes and Strategies

- Perform life cycle cost analysis.
- Integrate asset management in TMS multiyear or strategic plans.
- Develop obsolescence plans.
- Incorporate results of ITS asset management plans into agency:
 - TMS plans.
 - TSMO plans.
 - Transportation asset management plans.

For Additional Information

- Performance Measures and Health Index of Intelligent Transportation System Assets: FHWA-HOP-20-025 <https://tmcpfs.ops.fhwa.dot.gov/completedproj.htm>
- TMC Pooled Fund Study Projects and Resources: <https://tmcpfs.ops.fhwa.dot.gov>
- Other TMS Resources: <https://transportationops.org/traffic-management-systems-and-centers>.

