Managing Traffic Management System (TMS) Assets

**Transportation Management Center (TMC)
Pooled-Fund Study (PFS)
Federal Highway Administration (FHWA)
June 2024**

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Managing TMS Assets

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Introduction to Managing TMS Assets

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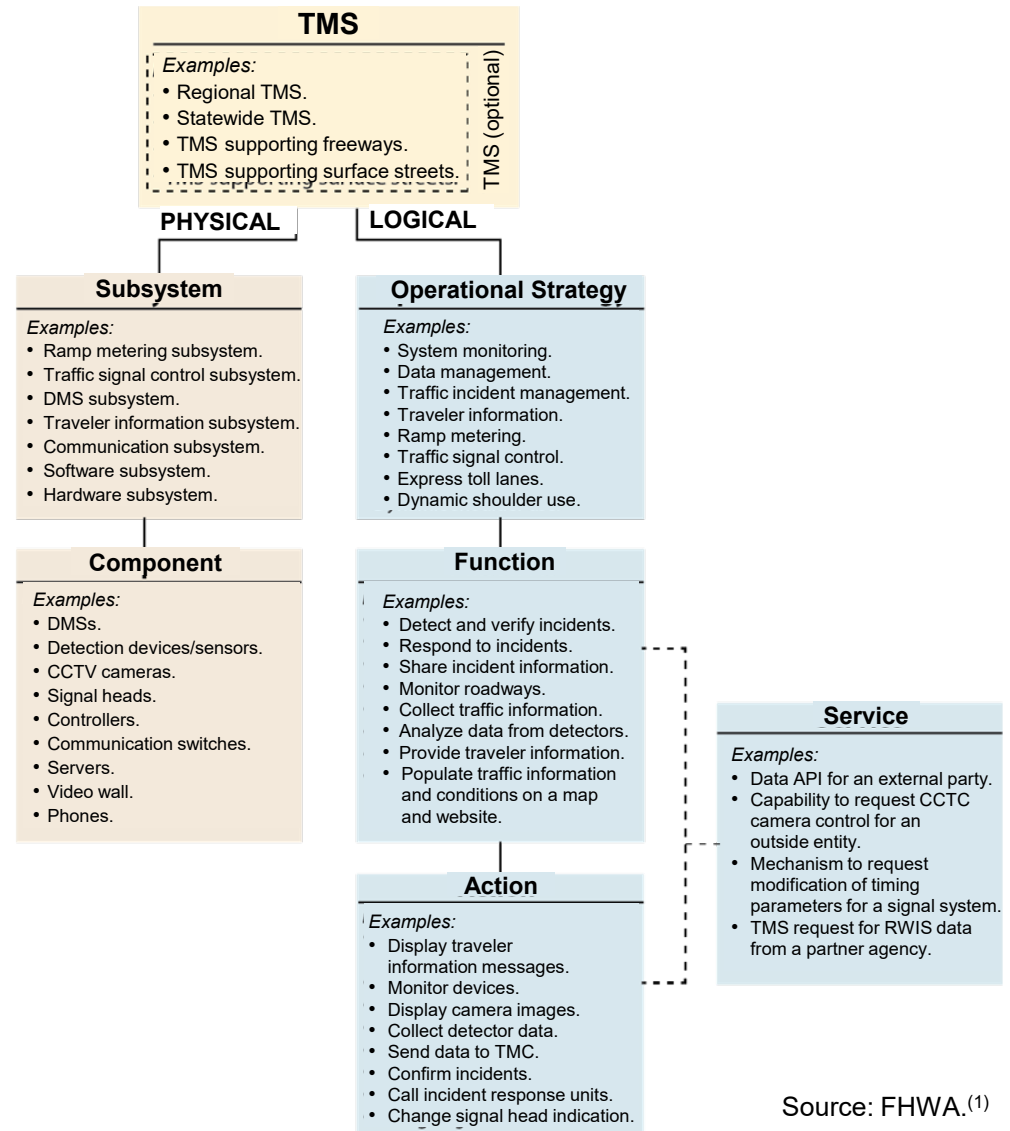
What Are TMSs?

- Complex operational systems that combine field equipment, advanced communications and information technology, and software.

- Software that collects and synthesizes traffic data, integrates external systems, and enables command and control of intelligent transportation system (ITS) field devices.

- TMS assets that are typically technology-based and must be managed differently than infrastructure assets.

TMS

Examples:
- Regional TMS.
- Statewide TMS.
- TMS supporting freeways.
- TMS supporting surface streets.

TMS (optional)

PHYSICAL **LOGICAL**

Subsystem

Examples:
- Ramp metering subsystem.
- Traffic signal control subsystem.
- DMS subsystem.
- Traveler information subsystem.
- Communication subsystem.
- Software subsystem.
- Hardware subsystem.

Operational Strategy

Examples:
- System monitoring.
- Data management.
- Traffic incident management.
- Traveler information.
- Ramp metering.
- Traffic signal control.
- Express toll lanes.
- Dynamic shoulder use.

Component

Examples:
- DMSs.
- Detection devices/sensors.
- CCTV cameras.
- Signal heads.
- Controllers.
- Communication switches.
- Servers.
- Video wall.
- Phones.

Function

Examples:
- Detect and verify incidents.
- Respond to incidents.
- Share incident information.
- Monitor roadways.
- Collect traffic information.
- Analyze data from detectors.
- Provide traveler information.
- Populate traffic information and conditions on a map and website.

Service

Examples:
- Data API for an external party.
- Capability to request CCTC camera control for an outside entity.
- Mechanism to request modification of timing parameters for a signal system.
- TMS request for RWIS data from a partner agency.

Action

Examples:
- Display traveler information messages.
- Monitor devices.
- Display camera images.
- Collect detector data.
- Send data to TMC.
- Confirm incidents.
- Call incident response units.
- Change signal head indication.

Source: FHWA.[1]

API = application programming interface; DMS = dynamic messages sign; RWIS = Roadway Weather Information System.

TMS Asset Characteristics

TMS assets are unique from traditional transportation assets, such as pavements and bridges, because of their complexity and because they are based on technologies. Characteristics of TMS assets include:

- Technological elements.

- Monitoring.

- Failure mode.

- Functional obsolescence.

- Fungibility.

- Portability.

- Communications.

Transportation Asset Management (TAM)

23 Code of Federal Regulations (CFR) § 515.5 defines TAM as:[2]

> *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 life cycle of the assets at minimum practicable cost.*

How Does Managing Assets Differ From Asset Management?

Managing assets focuses on:

- Caring for assets to support availability, reliability, and dependability.
- Managing data that defines the assets, such as make and model, locations, quantities, and conditions.
- Understanding needs and conducting maintenance and repairs.
- Monitoring and measuring asset performance.
- Identifying resources and tools to support managing the assets.

Asset management focuses on:

- Identifying how assets address agency objectives.
- Predicting and planning for long-term outcomes.
- Measuring how assets contribute to agency value.

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What Are the Connections Between Transportation System Management and Operations (TSMO) and Managing TMS Assets?

Potential connections within a TSMO program and the management of TMS assets may include:

- Strategic connections—Includes functional and performance objectives and priorities for services and functions for TMS assets.

- Programmatic connections—May include staffing for operations and maintenance staff, business processes, and budgeting.

- Tactical connections—Includes financial planning and performance assessment.

What Are the Benefits of Managing TMS Assets?

o   Achieving and sustaining desired performance (e.g., state of good repair).

o   Managing TMS assets' lifecycles.

o   Improving asset performance and thus, the overall system.

o   Integrating conditions of assets and resources into how they are managed, maintained, operated, repaired, replaced, and retired.

What Is the Value of Managing Assets in TMS Processes and Plans?

- Developing and managing reliable and useful data about agency TMS assets.

- Collecting, managing, and maintaining data to assess condition, performance, and needs.

- Providing information to report to various audiences.
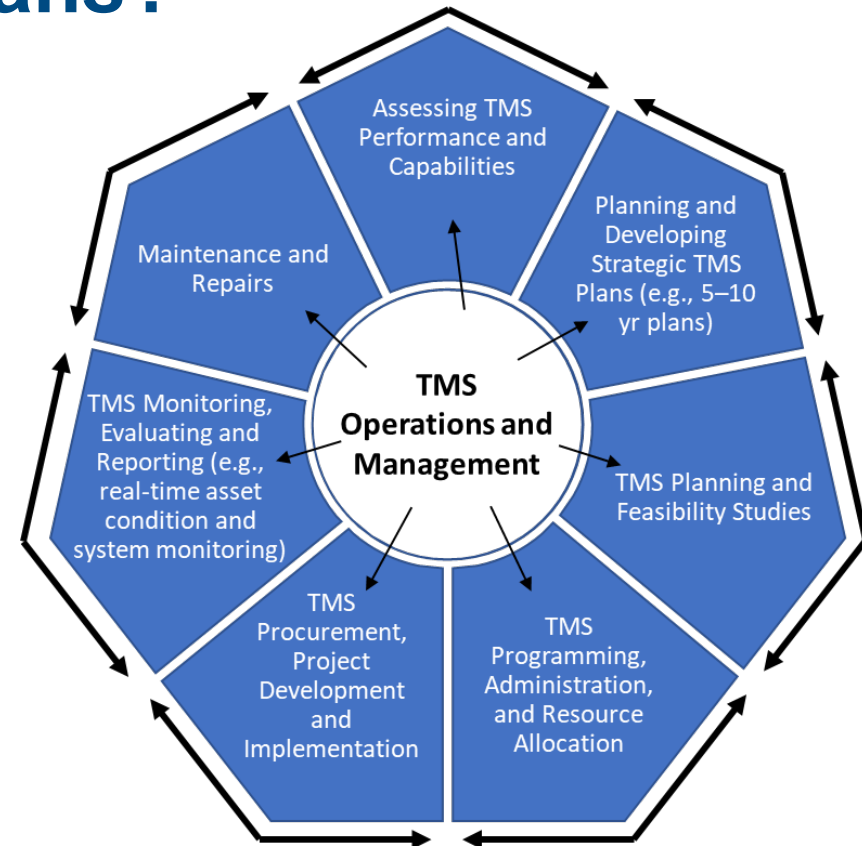
Source: FHWA.[3]

Managing TMSs Asset Activities
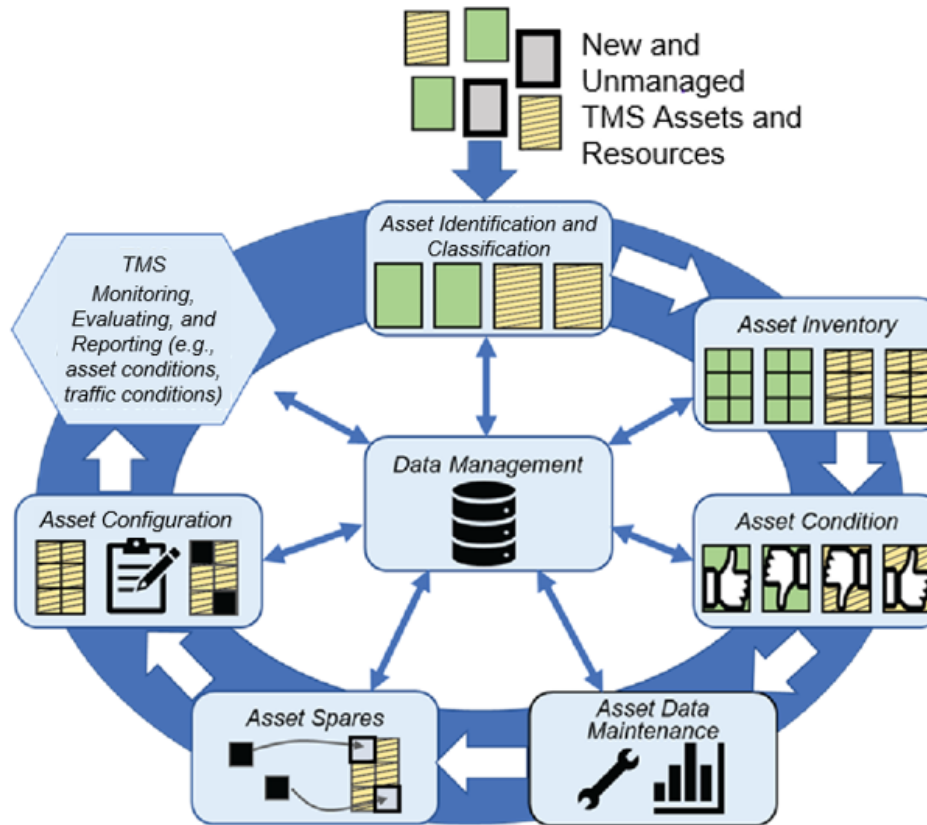
Source: FHWA.[3]

TMS Asset Identification and Classification

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Identifying TMS Assets

The identification process establishes the TMS assets to be managed:

- What assets can be managed:

  o Are appropriate data available?

  o Can agencies improve life expectancy and performance by monitoring their condition and taking appropriate actions?

- What assets are worth managing? Will the benefits of managing the asset exceed the resources required?

- What benefits does the agency expect to gain by managing an asset? Are objectives and targets (e.g., availability or reliability targets) defined?

> *Utah Department of Transportation (DOT): "The challenge in identifying assets is determining what to inventory and what not to inventory."*[4]

Classifying TMS Assets

- Classification organizes TMS assets in terms of data collection, management, and analysis.

- Groups can be formed around similar functions or characteristics:

  o Risks of adverse impacts to travelers or the agency.

  o Performance measures and targets for each tier or class.

  o Condition levels and maintenance needs of assets.

Tier 1	Tier 2	Tier 3
• ATMS servers. • Database servers. • Communication servers. • Advanced traveler information servers. • ATMS software. • Primary communication media (e.g., truck fiber). • Vehicle detectors. • CMSs. • Primary communication hardware (layer three hub switches). • Overheight vehicle detection systems. • Electronic clearance. • Traffic signal controllers. • Traffic signals heads and hardware.	• CCTV surveillance cameras. • Road weather information systems. • Secondary communication media (e.g., branch fibers). • Video wall controllers. • Video monitors/projection units. • ATMS workstations. • Secondary communication hardware (e.g., layer 2 switches and edge switches). • Ramp meters. • Automated license plate reader cameras.	• Highway advisory radio. • Weigh in motion. • Emergency call boxes. • Portable signs. • Portable detectors. • Portable cameras. • Connected vehicle onboard units and roadside units.

ATMS = advance transportation management system; CCTV = closed-circuit television; CMS = changeable message signs.

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TMS Asset Identification and Classification Practices

- Identify the TMS assets an agency can manage to help improve TMS performance, condition, and lifespan:

  - What activities will be performed to manage TMS assets?

  - What resources are required?

- Classify the identified TMS assets. Classification helps define how each asset is managed (e.g., critical assets will be more actively managed than noncritical assets).

TMS Asset Inventory

What Is a TMS Asset Inventory?

An inventory describes a TMS's assets and supports understanding asset condition, performance, and needs.

- Each asset is described by attributes, such as:

  o Quantity.

  o Make and model.

  o Age.

  o Location.

  o Condition.

- An inventory is limited by the data that are available and can be collected and has utility for managing the assets:

  o Not all available information has value for managing an asset.

  o Too much information may make data management overly complicated.

Inventory Framework(3)

Enterprise-Level Inventory: Comprehensive view of all assets owned, operated, maintained, and/or monitored by the agency. Allows for holistic understanding of the interaction between all asset classes and the relationships of the various asset classes to overall safety, mobility, and asset performance.

Asset Class-Level Inventory: A collective view of all assets within a defined asset class. Allows for analysis and understanding of the operation and maintenance of all the assets holistically within the class. Example asset classes typically include bridges, pavement, traffic signals, ITS devices, etc.

Asset Subgroup-Level Inventory: A specialized group of assets within an asset class within the same characteristics and functions, such as the type of pavement (asphalt versus concrete) or the type of ITS device (ITS cabinet, camera, dynamic message sign, RWIS, smart warning device, etc.).

Asset-Level Inventory (ITS assets): The listing of individual assets and all information tracked for these assets, including but not limited to general characteristics, inspection and condition assessment data, performance metrics, preventative maintenance plans, and work management information.

Source: FHWA.[5]

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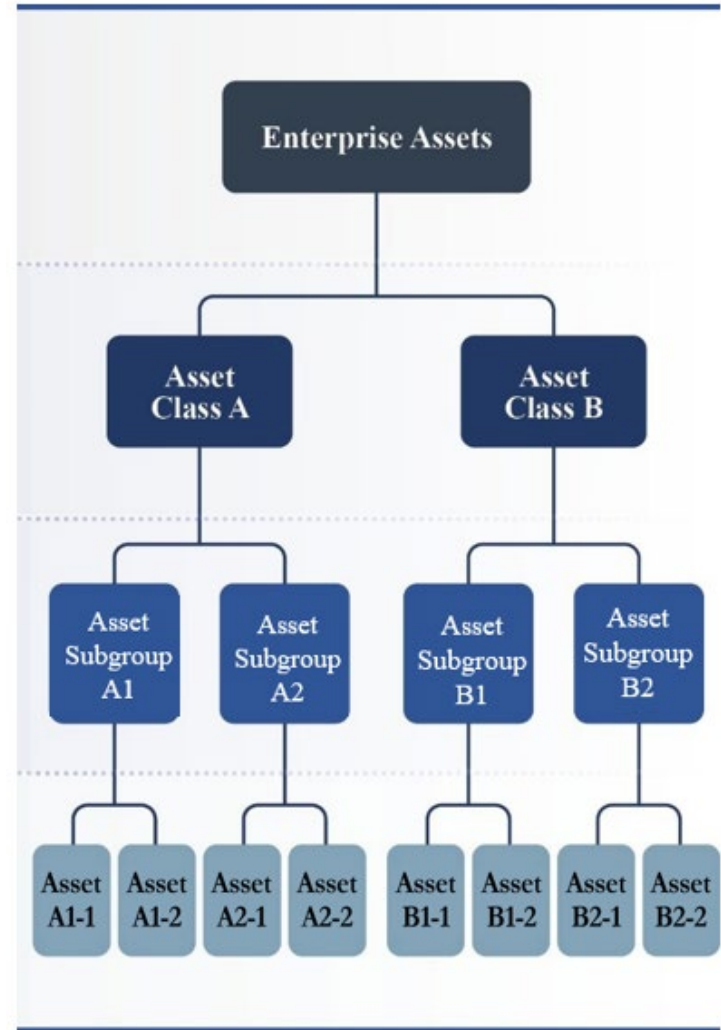
Asset Data Frame

Example of framework for defining asset inventory:

- Asset type—Correlates to subgroup and may define the type or class of the asset (e.g., camera, signal, etc.).

- Profile—Identifies information that may distinguish assets of a similar type (e.g., make and model).

- Instance—Attributes that uniquely describe each asset (e.g., location, condition, maintenance history, etc.).
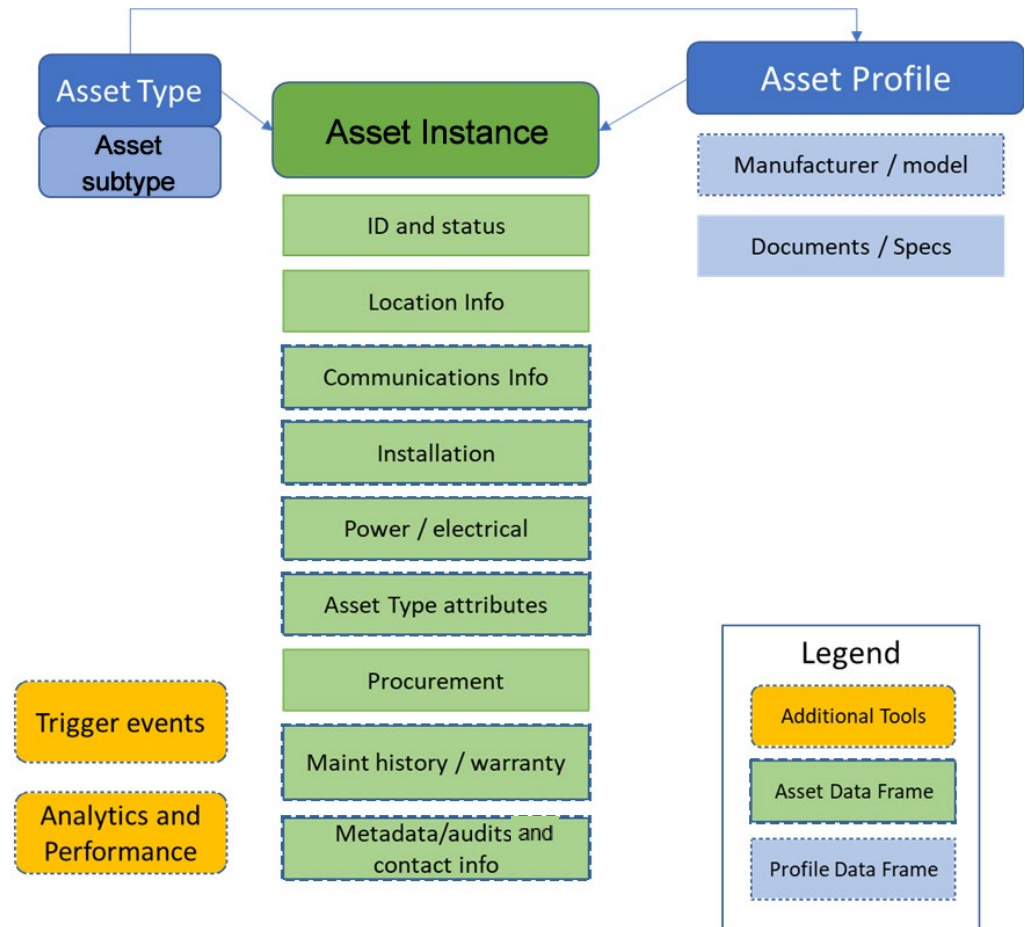
© 2022 New York State DOT.[3]

ID = identification; maint = maintenance; specs = specifications.

TMS Asset Lifespan as an Attribute

Agencies are challenged to estimate the lifespans of technology assets:

o Based on manufacturer guidance (e.g., manufacturer's documented estimate or manufacturer warranty).

o Based on historical lifespans observed for various asset types.

o Derived from estimates of lifespans for different device types, by asset type.

ITS Component	Lifetime (years)
Dynamic message sign	20
Dynamic message sign—portable	14
CCTV camera	10
Highway advisory radio transmitter	20
Highway advisory radio flashing beacon	10
Electronic toll-tag reader	10
Wireless communications (high usage)	20

Estimate of TMS Asset Lifespans.[1]

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[1] Interview with Pennsylvania DOT conducted on October 28, 2020.

TMS Asset Inventory Practices

- Select attributes that help:
  - o Classify the assets.
  - o Define the assets.
  - o Provide an understanding of performance and condition.
  - o Support the activities that manage the assets.
- Consider:
  - o How and where inventory information is collected and stored.
  - o What tools are needed to manage inventory data.
  - o What practices already exist or are needed to ensure the inventory is accurate and up-to-date.

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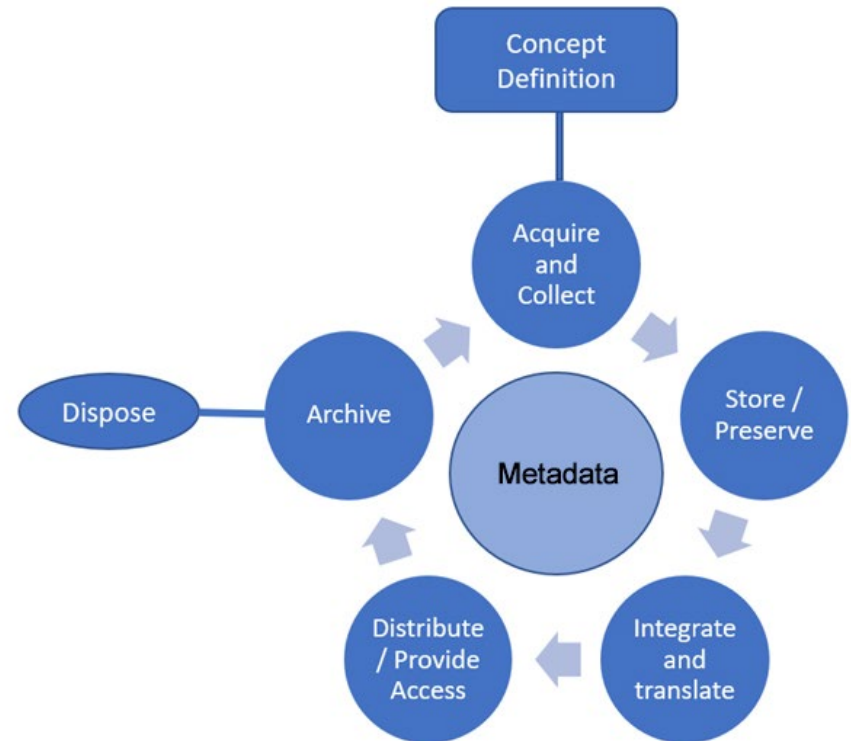
TMS Asset Data Management

What Is TMS Asset Data Management?

- Data management is the activities and resources to collect, store, and access the inventory data.

- Does the agency:
  - Know where its data reside?
  - Have processes for consistently documenting asset information?
  - Have appropriate tools for storing and using data?
  - Have access to the data (between systems and for staff)?

- Data management is the heart of managing TMS assets!

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TMS Asset Data Management Activities and Resources

- Data principles: Does an agency already have principles in place?

- Data curation: How are data managed over the data's lifetime?

- Data quality factors:
  - What are the expectations for data quality?
  - What activities, tools, and resources are needed to meet expectations?
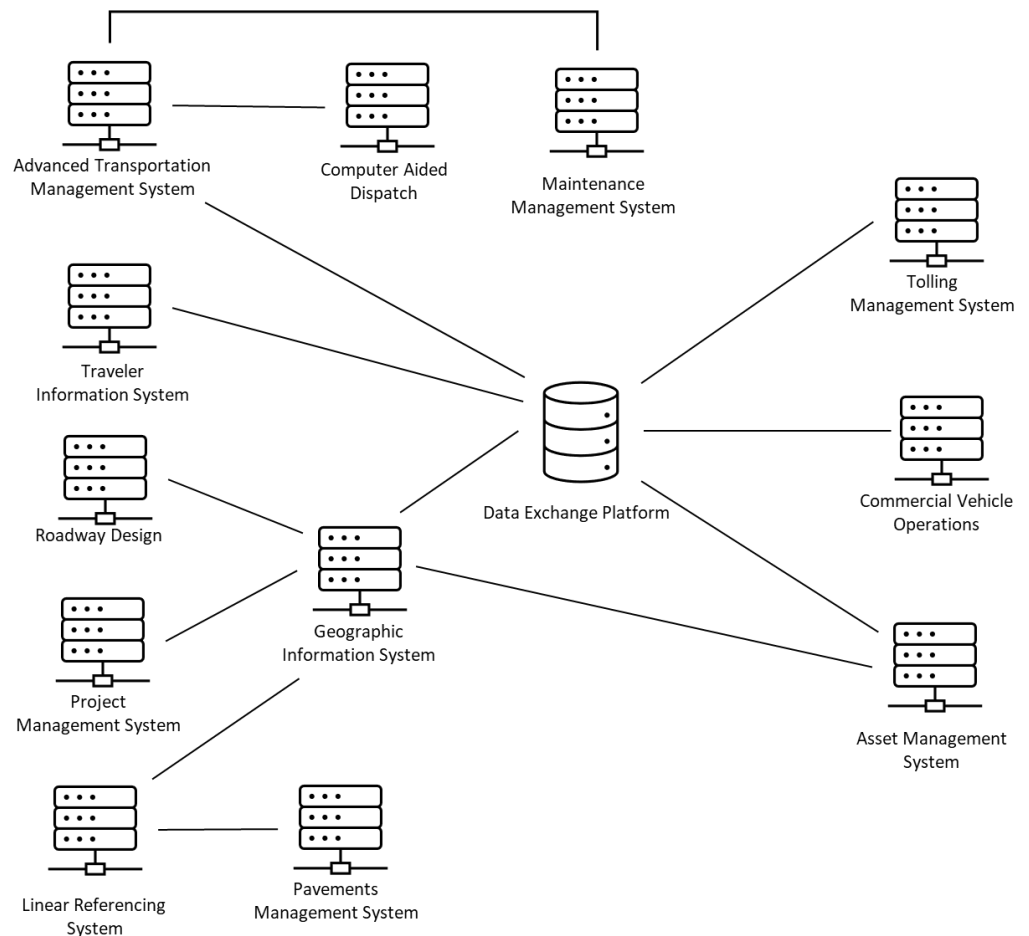

Source: FHWA.[3]

TMS Asset Data Management Tools

- **Tools for managing TMS asset data:**
  - What functions are needed?
  - What tools does the agency already have?
- **Data access and sharing:**
  - Is access through the tools secure?
  - Do the appropriate people and systems have access to properly manage the assets?

Source: FHWA.[3]

TMS Asset Data Management Practices

- Consider existing data management practices:

  o Do defined principles exist?

  o Does a data management plan exist?

  o What tools does the agency have, and do they meet the needs for managing TMS assets?

- Consider how data will be managed:

  o Who will collect them?

  o Who will perform data curation and ensure data quality?

  o How will data be shared?

TMS Asset Condition

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Considerations for TMS Asset Condition

Condition is used to define expectations for assets:

- Agencies may consider the following in determining condition:
    - Age.
    - Performance.
    - Use.
- Condition supports understanding an asset's needs and ability to meet performance targets.
- Condition may be used to estimate maintenance and replacement.

Using Condition to Estimate Maintenance

- Condition may be used to estimate maintenance and replacement needs.
- Nevada DOT (NDOT) estimates types and probabilities for maintenance activities for assets based on age.[6]

Condition	Age
Good	Within first 80 percent of expected life.
Low Risk	Between 80 and 100 percent of expected life.
Medium Risk	Between 100 and 125 percent of expected life.
High Risk	Over 125 percent of expected life.

NDOT ITS Condition Assessment.[6]

Maintenance Type	Good Condition (percent)	Low Risk Condition (percent)	Medium Risk Condition (percent)	High Risk Condition (percent)
Inspection	100	100	100	100
Minor	—	10	30	10
Major	—	—	10	25
Replacement	—	—	—	10

—No data.

NDOT Maintenance Needs for Cameras by Condition.[6]

Data That Support Assessing Condition

- Data collected during procurement:
  - o Specifications, make and model, operating systems, and firmware.
  - o Dates of procurement (age).
  - o Manufacturer guidance on maintenance and expected lifespan.
- Maintenance history over the lifespan of the asset:
  - o Maintenance activities.
  - o Configuration changes and verification.
- Operational status of the asset:
  - o Mean time to failure.
  - o Percentage of time the asset is available and providing its functions.
  - o Frequency of failure.
  - o Work orders.

TMS Asset Condition Practices

- Consider previous experience:

  - What attributes have proved accurate in assessing condition (e.g., age, use, maintenance history)?

  - Is the condition of an asset defined by the condition of one of its elements (e.g., is the logic board a common failure point in a sign)?

- Consider the availability and quality of data:

  - Are data recorded consistently?

  - Does a clear definition exist for each condition (e.g., good, fair, poor)?

- Define condition to support managing assets:

  - NDOT estimates maintenance needs based on condition.[6]

  - Condition and asset class may help identify maintenance priorities.

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TMS Asset Data Maintenance

What Is TMS Asset Data Maintenance?

- Management involves collecting, storing, and sharing asset data.

- Maintenance involves keeping that data accurate:

  o How have the assets changed?

  o What maintenance has been done to the assets?

  o How have expectations for the asset changed?

- Maintenance supports data quality and provides an accurate view of the assets, including their conditions, performance, and needs.

- Current and historical asset data have value in establishing expectations for an asset.

Considerations for TMS Asset Data Maintenance

- Establishing data collection early in an asset's life:
  - Creates a baseline of an asset's composition.
  - Documents the performance expectations for evaluation through the asset's lifetime.

- Integrating changes to assets into data collection and management:
  - Documents changes in composition and expectations.
  - Tracks the impact of changes on condition and performance.

- Governing the data:
  - Ensures consistency in data maintenance.
  - Defines roles and responsibilities.

Data Governance

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The Florida DOT (FDOT) Reliable, Organized, Accurate, Data Sharing (ROADS) data governance initiative is organized around:[7]

- People.
- Processes.
- Technology.

TMSs Asset Data Maintenance Practices

- Maintain data over assets' lifecycles:

  o Assets change over time, and so will the expectations for the assets.

  o Data accuracy supports maintenance and condition assessment.

- Data governance supports data maintenance:

  o Establish data maintenance roles and responsibilities.

  o Define how data tools and processes will be used to keep data up-to-date.

TMS Asset Spares and Support Resources

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The Role of Spares in Managing TMS Assets

Spares are replacement components and devices that can be repaired or swapped:

- Having spare parts in the right quantities, in the right places, and at the right times supports keeping assets operational.

- To have spares available, agencies may:

  o Contract with vendors to ensure spares will be available.

  o Arrange for just-in-time delivery of spares.

  o Plan to store and inventory spares.

Forecasting the Need for Spares

Considerations in spare forecasting:

- How often are spares used?

- How long does the procurement process take?

- How critical are the spares, and how many are needed in the case of widespread failures?

- When can an agency procure spares (funding availability, budget schedules)?
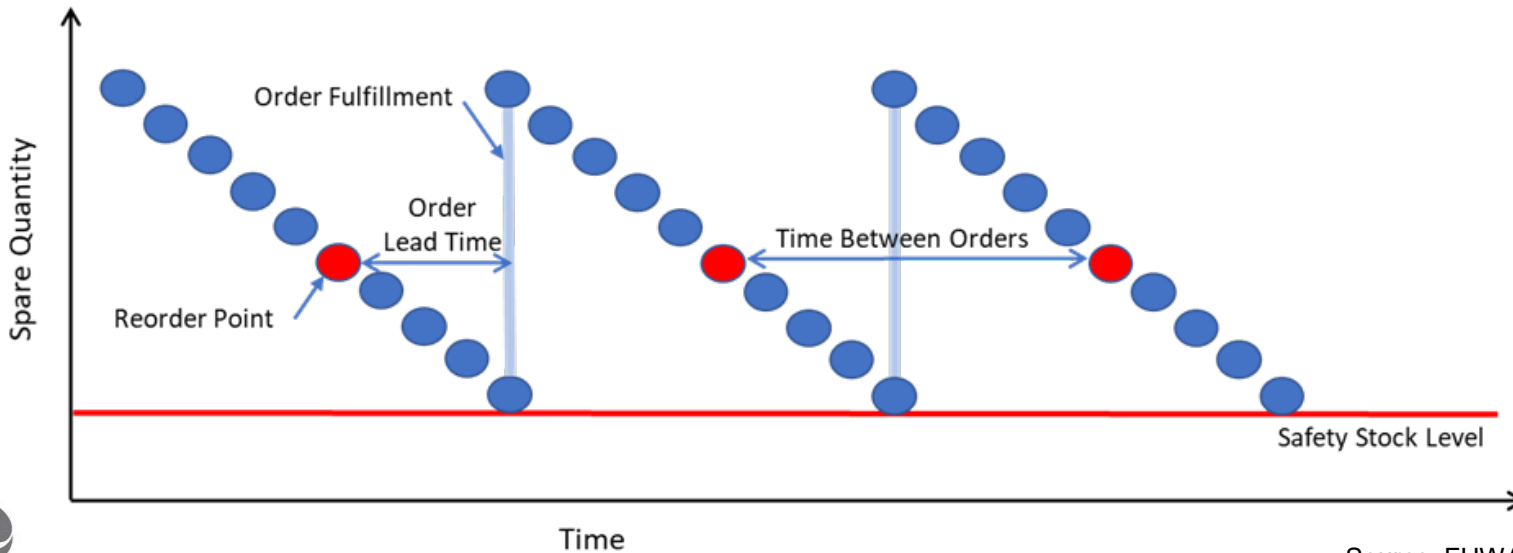
Source: FHWA.[3]

TMSs Asset Spares and Resource Practices for Support

Agencies may want to consider the following practices:

- Require the availability of spares for the lifespan of assets during procurement.

- Consider the class of the assets in determining the need for spares.

- Factor in procurement, budget cycles, and delivery times when planning spare inventories.

- Consider just-in-time delivery or vendor storage for fragile spares.

- Use data management tools to track the usage and availability of spares.

TMS Asset and Resource Configuration

What Is Configuration Management?

The Configuration Management for Transportation Management Systems Handbook defines configuration management as:[8]

> *Programs and plans provide the technical and administrative direction to the development and implementation of the procedures, functions, services, tools, processes, and resources that are required for the successful development and support of a system.*
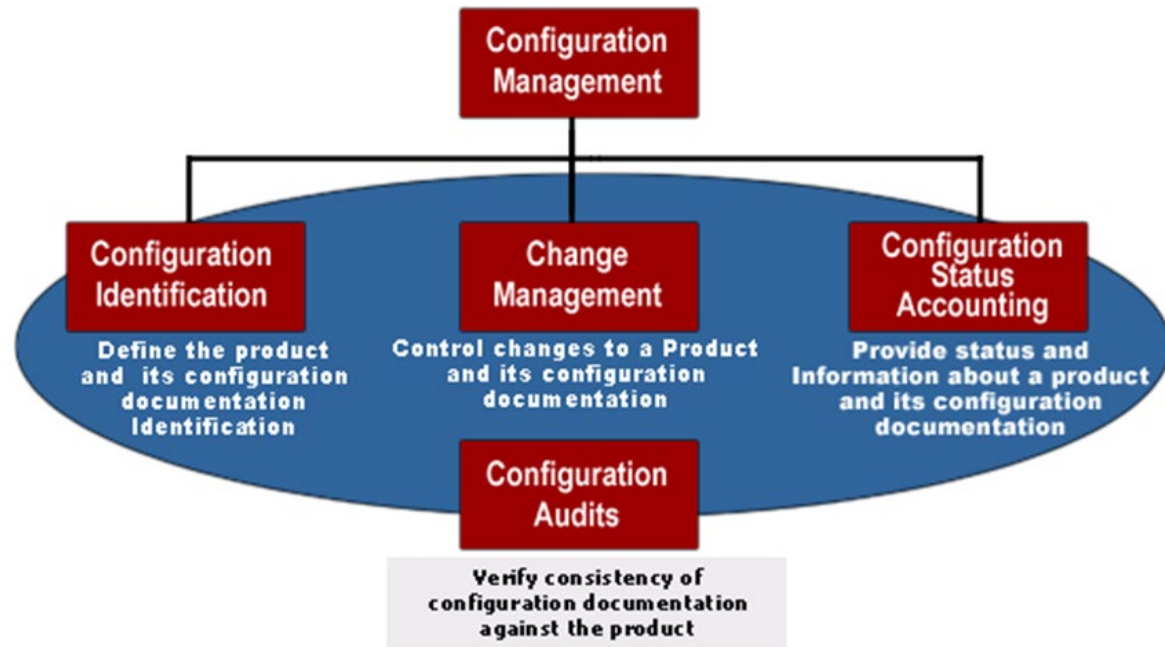
TMS Asset Configuration Management

Configuration management documents and manages changes to TMS assets, such as a changes in operating systems or the installation of a spare. Configuration management can do the following for agencies:

- Provide history on what a TMS asset has been previously and information on what the asset is currently composed of.

- Verify TMS assets are as expected or identify how they have changed.

- Result in better understanding of TMS assets—Inventory, history, condition, and performance expectations.

Configuration Management Processes in Managing TMS Assets

- Having uniform identifiers for assets across tools and resources.

- Understanding when and why changes are made and by whom.

- Incorporating change documentation and verification into existing processes (e.g., maintenance activities).

- Tracking changes to assets in data management tools.

Source: FHWA.[3]

TMSs Assets and Resource Configuration Practices

- Consider whether a configuration management plan exists:

  - Who performs configuration management?

  - Are TMSs assets included in the plan?

  - What activities are in the configuration management plan, and how do they align with the activities for managing assets?

- Capture metadata about assets:

  - Who made changes, and when?

  - Why were changes made?

- Incorporate configuration into existing activities:

  - TMS asset configuration of field devices can be verified during maintenance.

  - Configuration can be documented from procurement through asset retirement.

TMS Asset Monitoring, Evaluating, and Reporting

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What Is the Role of Monitoring, Evaluating, and Reporting TMS Assets?

Monitoring, evaluating and reporting uses a TMS's asset data management tools to inform on condition, performance, and needs:

- Monitoring assets provides an agency with realtime information about asset statuses.

- Using asset data allows agencies to evaluate condition and performance and compare these results to targets.

- Reporting asset data synthesizes data for reports to various audiences on condition, performance, and needs.

Monitoring TMSs Assets

- Existing tools and available data may provide monitoring capabilities (e.g., network monitoring or advanced transportation management systems).

- The appropriate level of detail for the data may differ by asset class (e.g., does a highway advisory radio on a remote road need to be monitored as frequently as an urban changeable message sign?).

- Monitoring may be performed as part of the roles of traffic management center operators and information technology and maintenance staff.

Asset Attributes	Collection Frequency
Device up/down availability	Once every 5 min.
Over-temperature alarms	Once every 5 min.
Humidity alarms	Once every 5 min.
Pixel/lamp errors	Once every 5 min.
Power errors	Once every 5 min.
Communication errors	Once every 5 min.
Fan alarms	Once every 5 min.

Example Monitoring Frequency for a Changeable Message Sign.[9]

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Evaluating TMSs Assets

- In evaluating assets, an agency compares its data to its expectations.

- An agency requires performance measures that use asset data.

- Agencies may consider the following during evaluation:

  o Are the measures appropriate for the asset classification?

  o Are the measures linked to the agency's overall performance goals?

  o Can the measures be evaluated?

 o Are the measures understandable?

Examples of measures:[9]

- Asset health, uptime, and reliability.

- Mean time between failures.

- Mean time to repair.

- Malfunction and issue type.

- Repairability.

- Cost to maintain.

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Reporting on TMS Assets

- Reporting uses asset data to tell others about:

  o Condition and performance—Are the assets meeting targets? Why or why not?

  o Needs—Maintenance, resources, or additional assets to meet targets.

  o Costs and value—How much is being spent or will be spent?

- Reporting is different for each audience:

  o Decisionmakers may want high-level summaries—How much will it cost?

  o Operational staff may want to know TMS condition and performance.

  o Maintenance may want specific device or component information.

Annual Costs - Statewide ITS Assets
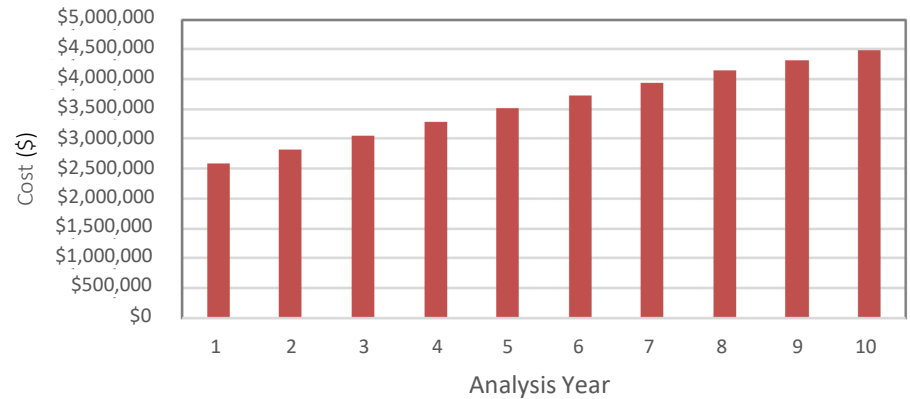
© 2020 NDOT.[3]

TMS Asset Monitoring, Evaluating, and Reporting Practices

- Consider the monitoring activities already performed:

  o What data are encountered in a TMC by maintenance and information technology staff?

  o Are the resulting data collected? What, if any, processes exist on how to use that data?

- Consider evaluation when data is collected, managed, and maintained. Accurate evaluation relies on quality data that provide meaningful information on TMS asset performance, condition, and needs.

- Consider the audience when reporting:

  o Quality data can be "rolled up" to different levels of detail, depending on the audience.

  o What does the audience need to know, and how can the agency's asset data inform them?

TMS Resources

- TMC PFS website.[10]

- National Operations Center of Excellence (NOCoE) TMS portal.[11]

- Next Generation of TMSs Resources.[12]

TAM Resources

- FHWA Asset Management Portal.[13]

- Managing TMS Assets.[3]

- *Applying Transportation Asset Management to Intelligent Transportation Systems Assets: A Primer*.[14]

- *Applying Transportation Asset Management to Traffic Signals: A Primer*.[15]

- *Handbook for Including Ancillary Assets in Transportation Asset Management Programs*.[16]

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Speaker's Notes

Speaker's Notes (1/56)

The TMC PFS is a group of public agencies and organizations who voluntarily pool funds each year and collaborate on projects to develop technical resources and advance activities to address the key challenges and issues they are collectively facing in support of improving performance, capabilities, and how they manage and operate their Traffic Management Systems (TMS) and Centers (TMC).

This presentation was developed as part of the TMC PFS project on TMS Asset Management and Life Cycle Cost Analysis.

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Speaker's Notes (2/56)

This presentation includes ten sections:

1. Introduction to Managing TMS Assets

2. TMS Asset Identification and Classification

3. TMS Asset Inventory

4. TMS Asset Data Management

5. TMS Asset Condition

6. TMS Asset Data Maintenance

7. TMS Asset Spares and Support Resources

8. TMS Asset and Resource Configuration

9. Monitoring, Evaluating, and Reporting on TMS Assets

10. TMS Resources

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Speaker's Notes (3/56)

None.

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Speaker's Notes (4/56)

None.

Speaker's Notes (5/56)

In managing TMS assets, it is important to understand that they are unique from traditional transportation assets such as pavement and bridges because of their complexity and the unique aspects and technologies that may be incorporated into the different TMS components, devices, or elements. TMS assets will benefit from a unique approach to asset management because of their unique characteristics.

The characteristics include:

- **Technology elements** – TMS assets can require specialized skills, equipment, and materials to maintain them, and it may be more effective to manage them using an approach similar to how Information Technology (IT) assets are managed as opposed to the approach for managing traditional transportation assets.

- **Monitoring** – TMS assets that rely on technology can fail without warning or signs of degradation and may require constant monitoring if they are to be relied on. Agencies have established performance target for the availability of TMS assets which require frequent monitoring to verify.

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Speaker's Notes (5/56) – continued

- **Functional obsolescence** – A TMS asset can become obsolete due to changes to standards, software, a lack of spare parts, and changes in other systems with which it interacts.

- **Fungibility** – A TMS asset may be maintained through the replacement of their components or devices, which may alter its configuration, functionality, and performance.

- **Portability** – TMS assets such as work zone equipment and portable signs can be moved and may not have a fixed location.

- **Communications** – TMS assets are typically information technology and rely on communications networks to exchange that information. As such, the performance and reliability of a TMS asset may be impacted by communications issues beyond an agency's control.

- **Degradation** – TMS assets typically do not degrade in the same manner of roadway infrastructure assets which typically degrade gradually over time, through wear and environmental conditions. The condition of some TMS assets is binary – they are either operational or not operational

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Speaker's Notes (6/56)

Agencies are not required to include TMS assets in their transportation asset management. However, many agencies do, and many more agencies are interested in including them as TMS become increasingly important to their ability to achieve their missions.

Speaker's Notes (7/56)

What is managing TMS assets? How is it different from TAM? Asset management provides a planning and resource allocation perspective, while managing TMS assets is focused on operations and getting the most value out of the assets.

Managing TMS assets is focused on operations and ensuring that TMS assets meet their performance targets. However, the activities of managing TMS assets provide valuable information that may be used to support TMS asset management, but asset management is not the focus of this presentation.

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Speaker's Notes (8/56)

The reliance on TMS assets for TSMO is expected to rise steeply as transportation becomes increasingly automated. With significant investment in and focus on deploying technology, many agencies have been struggling to keep the assets maintained. TSMO and asset management programs share a strategic, performance-based approach to monitoring performance and applying actions to reach targets, and this approach can likewise be used to manage TMS assets.

Potential connections within a TSMO Program Plan for managing TMS assets as part of strategic TMS plans include:

- **Strategic connections** – This includes functional and performance objectives and priorities for services and functions for TMS assets.

- **Programmatic connections** – This may include staffing for operations and maintenance staff, business processes and budgeting.

- **Tactical connections** – This includes financial planning and performance assessment.

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Speaker's Notes (9/56)

Managing TMS assets supports an agency understanding what TMS assets it has, their condition and performance, and what to expect from them in the future.

This helps an agency in operating and planning and optimizing agency investment, which can result in improved return on investment, and potentially justify expanding the use of TMS to address agency objectives.

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Speaker's Notes (10/56)

Managing TMS assets relates to many agency plans and processes, primarily by developing and managing reliable and useful data about the agency's assets.

Managing TMS assets collects, manages, and maintains data to assess their conditions, performance, and needs. This includes monitoring the assets and having the tools to understand what monitoring data tells an agency about the assets. Evaluation uses a broad range of TMS asset data to assess the performance and value of the assets which can be related to agency expectations. TMS asset data, when managed properly, provides reliable information for reporting to audiences including those from operations, maintenance, and planning as well as executive-level staff.

Information and data resulting from Managing TMS Assets can also be incorporated into other agency processes which influence the lifecycle of a TMS, including other planning and programming processes such as TSMO planning and overall agency programming.

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Speaker's Notes (11/56)

This graphic shows how the activities relate to one another, with TMS asset data management being a key activity that relates to each of the others.

Speaker's Notes (12/56)

None.

Speaker's Notes (13/56)

Identification of TMS assets is done with the objective of establishing what assets may benefit from being managed. By managing TMS assets, an agency will expect to improve or maintain their functionality, reliability, performance, and/or lifespan. In addition, managing TMS assets provides organization and understanding of what an agency has, what those assets need and how to share information about them.

An example of an asset that may be identified to be managed is a new component, such as a Changeable Message Sign (CMS) deployed during a recent construction project, for which the agency is expecting high availability. An example of an asset that may not be identified for management is one whose role no longer supports agency objectives or that is nearing retirement, such as a remote Highway Advisory Radio (HAR) that is reaching the end of its expected lifespan.

Utah Department of Transportation's (DOT) inventory of TMS assets includes an asset category with corresponding asset components identified for each type of asset. Utah DOT said the challenge in identifying assets is "determining what to inventory and what not to inventory."

Speaker's Notes (14/56)

Classification involves organizing TMS assets in terms of data collection, management, and analysis. Classification can be completed using many factors, including similar functionality of the assets, relative impact or risks to the agency, performance expectations, or maintenance needs.

An example that uses intelligent transportation system (ITS) Asset Tiers to classify assets:

Tier 1:

- Asset is critical to operations.

- Minimal downtime is allowed.

- Measurement targets are identified and tracked in real-time.

- Receive dedicated prioritized funding

Speaker's Notes (14/56) – continued

Tier 2:

- Asset is highly beneficial to system operations.

- Device is repaired within reasonable timeframes.

- Measurement targets are identified and tracked.

Tier 3:

- Asset is beneficial but not critical to system operations.

- Item repaired or replaced when damaged or demonstrated degraded performance.

Speaker's Notes (15/56)

Agencies identify TMS assets to establish what assets may benefit from being managed and how asset management will benefit the systems efficiency and effectiveness. By managing TMS assets, an agency may expect to improve or maintain a device or elements' functionality, reliability, performance, and/or lifespan. The process of managing TMS assets provides a way to organize them and understand what resources those assets may need, what asset information can be used and shared, and how asset information could be used in other processes and decisions occurring over the TMS's lifecycle.

Asset identification leads to defining what information may be reasonable and feasible to collect to support the active management and operation of a TMS, other asset management activities, or processes and decisions in the lifecycle of a TMS. To determine the feasibility of managing an asset, agencies may consider the resources needed or the cost for collecting, inventorying, and managing the information.

Speaker's Notes (16/56)

None.

Speaker's Notes (17/56)

Inventory defines what an agency has at a level that is appropriate for managing those assets. Agencies may benefit from not trying to capture all attributes, but determining the attributes that have value for managing the assets, and only collecting and managing data for those attributes.

Speaker's Notes (18/56)

An inventory framework can define the levels of inventory. Different information may be relevant at each level. For example, at the sub-group level, an inventory attribute may be the quantity of traffic cameras. At the asset level, more detailed information such as make and model, location and age may be attributes.

Speaker's Notes (19/56)

An asset data framework frames what data will be collected for each asset and will align with data management tools and resources.

- Asset Type –The type of asset, such as a camera or CMS, and might also include classification. A description may cover many similar assets.

- Asset Profile – Designates assets of the same type and similar, such as make and model or being procured at the same time. For example, a group of camera deployed together.

- Asset Instance – Instance data represents a specific physical asset that is deployed or stored. For example, the instance is what is specific each Panasonic camera, such as its location, identification number, condition, etc.

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Speaker's Notes (20/56)

Lifespan is an important attribute in managing TMS assets because assets often do not degrade in a predictable way as infrastructure assets are often expected to. Lifespan provides agencies with a potential inventory attribute that can help them consider when to replace or retire assets before catastrophic failures or performance falls below targeted levels.

Agencies utilize different approaches to estimate asset lifespans.

- Nevada DOT and Washington State DOT base asset lifespan estimations on manufacturer guidance (e.g., manufacturer's documented estimate of lifespan or manufacturer warranty)

- Florida DOT, Georgia DOT, Minnesota DOT use historical lifespan observed for different asset types
  - Florida DOT collects detailed history on lifespan to estimate life expectancy
  - Georgia DOT considers spare parts availability in determining how long an asset can be expected to last

- Pennsylvania DOT uses estimated lifespans by TMS asset type, derived from FHWA estimates of lifespans for different device types

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Speaker's Notes (21/56)

Agencies benefit from right sizing their inventory and understanding the value of each attribute in the inventory. Acquiring, managing, and maintaining accurate asset data can be costly and challenging. Agencies benefit from understanding the value of their inventory to managing assets and then limiting the inventory to only the attributes with a clear purpose.

Speaker's Notes (22/56)

None.

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Speaker's Notes (23/56)

TMS asset data management describes the activities, tools, and resources that may be used to manage the identified and classified TMS assets and the inventory information that defines those assets. In developing an inventory, an agency has established the asset attributes that are useful for managing the assets and a structure for defining those attributes. Data management then is the process of populating, managing, and maintaining that inventory with accurate information that is made accessible to stakeholders.

Data management impacts and is impacted by every aspect of managing TMS assets.

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Speaker's Notes (24/56)

Agencies may already have data principles and management plans that can be applied to TMS asset data. The principles and plan may provide an understanding of how an agency treats data as an asset with a lifespan and with needs to be managed and maintained over that lifespan.

The diagram depicts how data is curated over its lifetime, from definition through collection and until retirement.

Speaker's Notes (25/56)

Agencies may have tools that already provide many of the data management functions. However, the functionality may be spread over many tools with different user groups, and with different needs. Because the data is often spread out over many tools, accessing it may be difficult. Also, the data for an asset may not be consistent across all tools with asset data.

The image shows an example of the many tools an agency may have that contain TMS asset data, and how the tools may connect and share that data.

Speaker's Notes (26/56)

Agencies may consider how data are treated from inception through retirement and whether the curation process adequately values and utilizes its data throughout the data's life.

Additionally, agencies already have data stored in tools that provide many of their needed functions. They will benefit from identifying data gaps and identifying how existing tools may be modified or other tools may be procured to fill the gaps and otherwise improve TMS asset data management. Agencies also may consider expanding their existing tools rather than procuring new tools, when feasible.

Speaker's Notes (27/56)

None.

Speaker's Notes (28/56)

Considerations such as age, performance and environment are key factors for assessing condition using TMS asset data.

Asset condition data may be used to estimate maintenance and replacement needs and support decision making such as which maintenance strategies are most appropriate.

Because asset condition is typically well understood by a wide audience, condition information can be used to report on TMS assets performance and needs.

Speaker's Notes (29/56)

As an example of how TMS asset conditions can be used to determine maintenance needs in a systematic fashion:

- Nevada DOT uses age to determine the condition of assets, defined as good, low risk, medium risk or high risk

- This information is used to estimate maintenance needs, categorized by maintenance type and risk level

- This information is also used to help estimate maintenance costs for assets

Speaker's Notes (30/56)

As previously discussed, the data that may be used for assessing condition must be collectible, accurate, and available for performing the condition assessment. An agency may consider what is important for condition assessment when defining inventory attributes, data management tools, and data management strategies to ensure that its data provides an accurate depiction of asset condition.

Speaker's Notes (31/56)

Agencies benefit from using accurate and available data to assess condition. Available data may not provide the most complete condition assessment but allow for assessments that are consistent and possible given resource constraints.

Agencies can also benefit from defining conditions in ways that clearly explain the health of TMS assets to stakeholders. While models exist to define condition of TMS assets as "Good," "Fair," and "Poor," agencies may benefit from determining condition ratings that support managing the assets and that align with asset prioritization and classification.

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Speaker's Notes (32/56)

None.

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Speaker's Notes (33/56)

Both historical and current data has value in managing TMS assets:

- Historical: can be used to analyze assets over their lifetime

- Current: provides information about current performance, condition, status and configuration

Speaker's Notes (34/56)

Agencies benefit from planning for data maintenance while planning data management. Even when data can be collected and stored, it can lose value if it is not continually updated over time.

Just as an agency may have a maintenance plan for its TMS assets, data governance provides a framework for maintaining the data, which can also be considered an asset.

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Speaker's Notes (35/56)

The Florida DOT's Reliable, Organized, Accurate, Data Sharing (ROADs) data governance initiative is a complete, yet simplified framework organized around:

- People, which incudes roles and responsibilities

- Processes, which define standards and rules that support best practices, ensures staff training

- Technology, which utilizes standardized tools and technologies to make data more accessible

Speaker's Notes (36/56)

Agencies benefit from having the resources and activities to not only collect and store data but to maintain it over the TMS's lifecycle. This practice includes identifying the data that will be updated, determining what will happen to data that does not represent the current state, and disposing of data that no longer has value.

Additionally, establishing schedules and processes for data collection and making TMS practitioners understand the importance of updating data in a timely manner supports having consistent and reliable data for performing analysis and making decisions.

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Speaker's Notes (37/56)

None.

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Speaker's Notes (38/56)

Examples of TMS assets spares include the elements or devices that comprise the TMS assets and that can be repaired or swapped. Examples, modems in field devices or logic boards for dynamic message signs (DMS). A spare part may also be a component, such as a complete CMS, when an agency cannot acquire the equipment or devices that comprise the CMS, or when replacing the equipment or devices will not result in a satisfactory repair.

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Speaker's Notes (39/56)

The sawtooth diagram shows the depletion of spares over time, and how that aligns with procurement processes and minimum stock levels to ensure an agency has adequate spares available to ensure TMS operate and meet performance targets.

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Speaker's Notes (40/56)

Agencies benefit from considering the repairability of an asset and the potential need for spares during the planning for new TMS. The TMS program-planning process is where spares management starts. The long-term viability of TMS assets will benefit when their long-term maintenance and health are considered in the planning and design of systems.

In considering the safety stock level, consider where those spares will be located, procurement timelines, and spares' availability.

Speaker's Notes (41/56)

None.

Speaker's Notes (42/56)

Essential to managing TMS assets is an accurate understanding of what the assets are, their configuration, and how they have changed over time.

Configuration management systematically handles changes so that a system maintains its integrity over time.

Speaker's Notes (43/56)

Configuration management supports:

- Comprehensive documentation of changes made to TMS assets over their lifetimes, including what is changed and when, why, and who made the changes.

- Preserving records of the history of previous asset configurations.

- Monitoring and tracking of the condition of the TMS assets.

- Documenting asset metadata.

Speaker's Notes (44/56)

The *Configuration Management for Transportation Management Systems Handbook*, published by FHWA, provides a detailed process for configuration management.

- Configuration Identification starts with identifying the equipment with a unique identifier, such as a unique identification number

- Change Management, or change control, is the process that assesses the impact of a change to a system, determines the fate of the proposed change, executes those changes that are approved, and ensures that the change is carried through.

- Configuration Status Accounting (CSA) is the process to ensure that the relevant information about a TMS asset – documentation and change history – is up to date and has the necessary information.

- Configuration Verification and Audit is the process of analyzing configuration items and their respective documentation to ensure that the documentation reflects the current situation.

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Speaker's Notes (45/56)

Agencies may already have plans and activities that define the expectations and processes for configuration management, and TMS assets may be included in those plans. The plans and processes may include resources and tools to support TMS asset configuration management.

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Speaker's Notes (46/56)

None.

Speaker's Notes (47/56)

- Monitoring assets provides an agency information about the status of assets – for example, to understand device functionality status and maintenance needs in real-time, or to assess asset health over time
  - TMSs data management tools may provide dashboards and other ways to monitor and collect asset status data.

- Evaluating provide an agency with information on how assets are performing compared to performance targets, and helps to evaluate each asset's condition

- Reporting includes synthesizing the data and sharing information with different stakeholders about the assets that help them make decisions.

Speaker's Notes (48/56)

Asset monitoring can be conducted through in-person observation or with remote monitoring using software tools that allow for observing the operations of field assets.

Speaker's Notes (49/56)

Evaluation relies on quality data, and often on data collected during monitoring. While monitoring gives real-time status, the evaluation of monitoring data can provide information on the performance of assets, such as shown in the examples in the table on this slide.

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Speaker's Notes (50/56)

The example is Nevada reporting its anticipated cost to maintain intelligent transportation system assets, it is rolled up from their asset data as shown earlier:

- quantity and types of devices.

- the assessed condition.

- cost estimates to maintain each asset based on condition.

This is representative of information for decisionmakers to use in budgeting and planning.

Speaker's Notes (51/56)

The practitioners who interact with the TMS assets daily benefit from having asset monitoring capabilities integrated into the tools they already use. For example, an operator in a control room may view camera images, traffic maps, computer-aided dispatch, and performance dashboards. Integrating monitoring capabilities into their existing tools may result in them being able to pay more attention to the status of the TMS assets. A TMS can provide alerts and alarms when an asset has a fault or notify TMC operators when an asset is no longer communicating.

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Speaker's Notes (52/56)

Additional TMS Resources include:

1. TMC PFS website.

2. NOCoE's TMS Portal.

3. NOCoE's TMS Staffing and Operators Resources page.

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Speaker's Notes (53/56)

Additional Traffic Asset Management Resources include:

- FHWA Asset Management Portal.

- FHWA's Managing TMS Assets report.

- FHWA's report on Applying Transportation Asset Management to Intelligent Transportation Systems Assets: A Primer

- FHWA's report on Applying Transportation Asset Management to Traffic Signals: A Primer.

- FHWA's Handbook for Including Ancillary Assets in Transportation Asset Management Programs.

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Speaker's Notes (54/56)

References include:

1. The National Archives and Records Administration's eCFR: 23 CFR Part 515—Asset Management Plans.

2. NOCoE's Asset Management: Virtual Peer Exchange Proceeding Report.

3. Nevada DOT's ITS Asset Management Business Plan.

4. Florida DOT's Data Governance web page.

5. FHWA's Configuration Management for Transportation Management Systems Handbook.

6. FHWA's Report on Performance Measures and Health Index of Intelligent Transportation Systems Assets.

7. FHWA's TMC Pooled-Fund Study web page.

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Speaker's Notes (55/56)

None.

Speaker's Notes (56/56)

None.