Establishing and Using a
Traffic Management System Inventory

Transportation Management Center (TMC)

Pooled-Fund Study

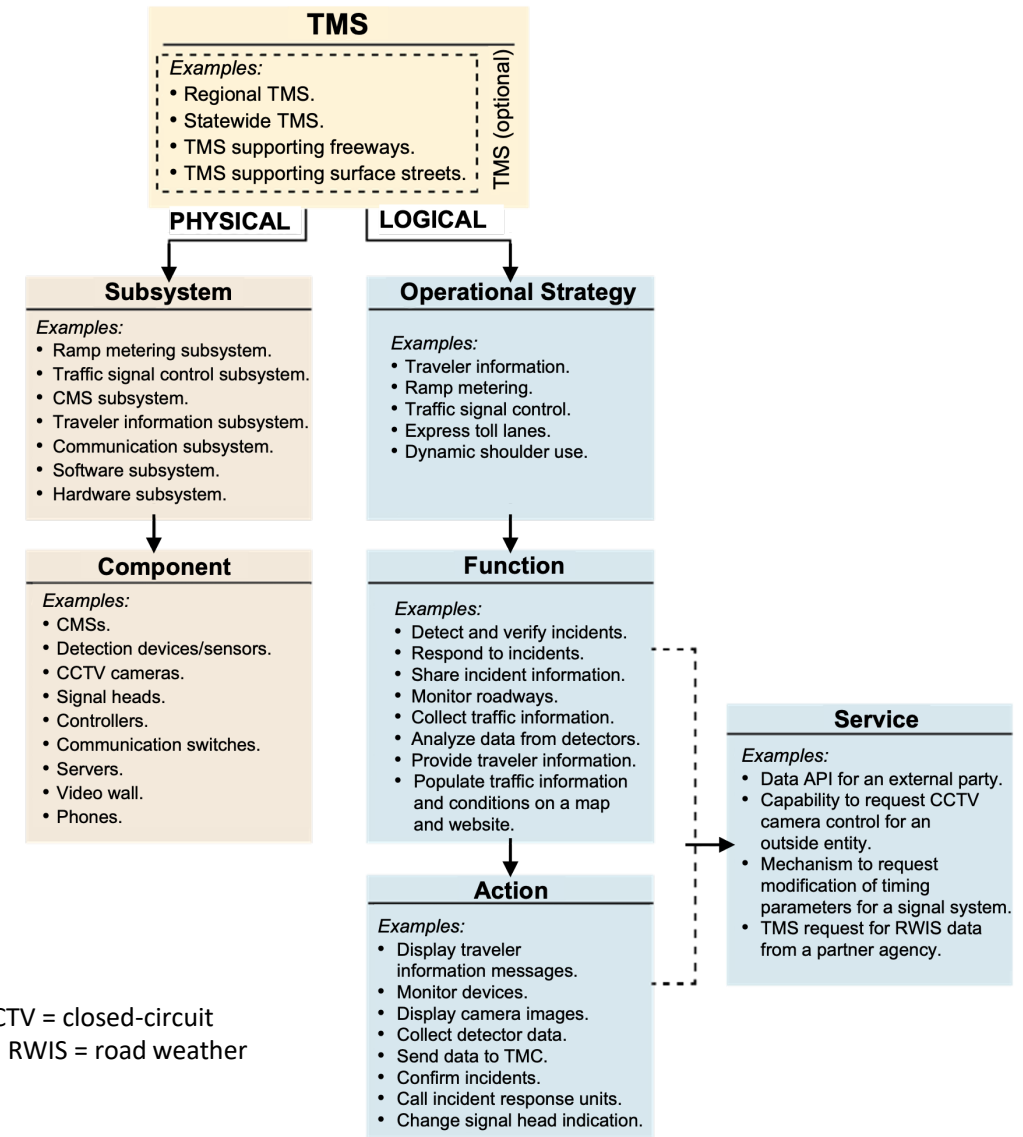**Federal Highway Administration (FHWA)**

November 2024

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TMSs

TMS design and structure can be divided into physical elements and logical elements.

- The physical elements are the subsystem and the components.
- The logical elements are operational strategies, functions, actions, and services.

TMS
TMS (optional)
Examples:
- Regional TMS.
- Statewide TMS.
- TMS supporting freeways.
- TMS supporting surface streets.

PHYSICAL

LOGICAL

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

Operational Strategy
Examples:
- Traveler information.
- Ramp metering.
- Traffic signal control.
- Express toll lanes.
- Dynamic shoulder use.

Component
Examples:
- CMSs.
- 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 CCTV 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.

API = application programming interface; CCTV = closed-circuit television; CMS = changeable message sign; RWIS = road weather information system.

Note: The solid lines show the internal system hierarchy, and the dashed lines show the need for connection to external systems.

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Source: FHWA.[1]

Managing TMS Assets

Activities conducted throughout the TMS lifecycle to manage assets may include:

- Preparing to manage TMS assets

- Managing TMS asset data, which includes identifying, classifying, and inventorying

- Maintaining TMS asset data, which includes condition rating, data maintenance, asset spare management, and management of the configuration of assets

- Monitoring, evaluating, and reporting on TMS assets

Source: FHWA.[2]

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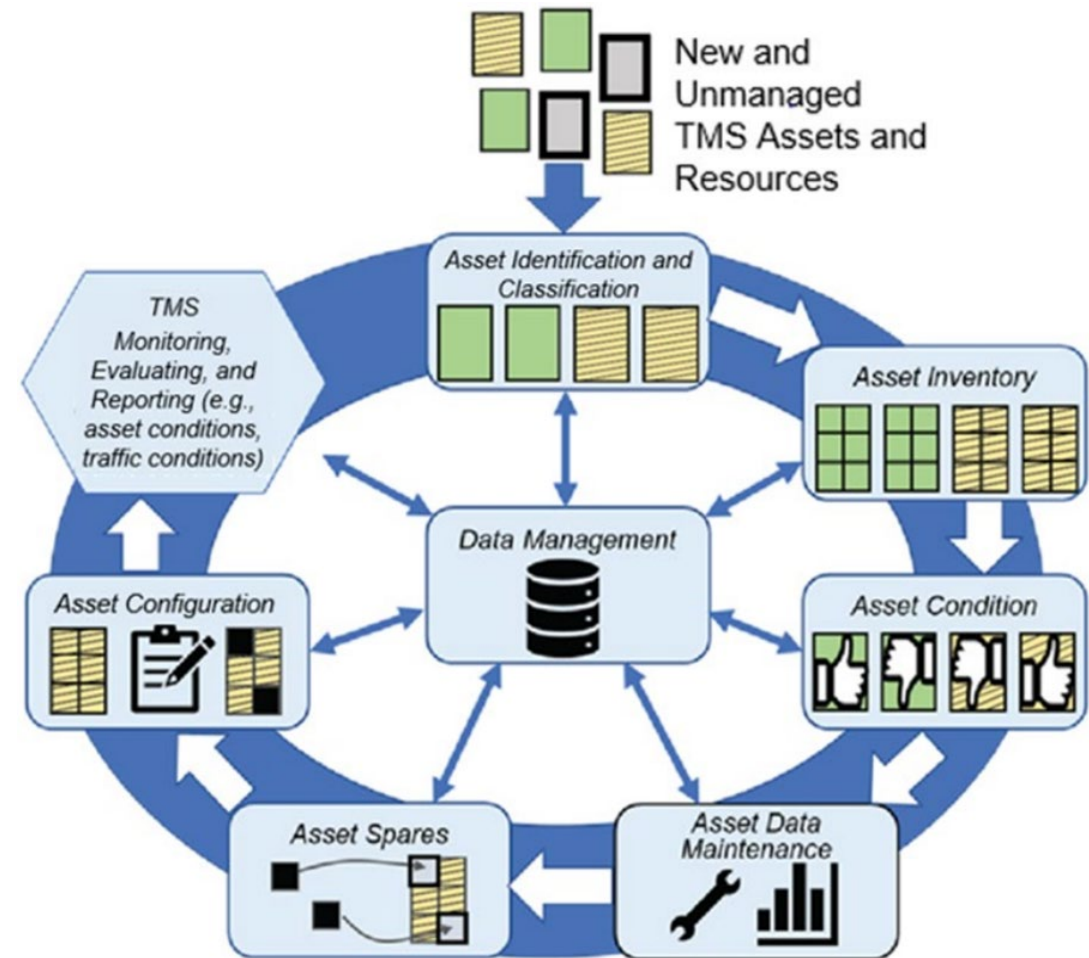
What Is a TMS Asset Inventory?

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

- Each asset is described by attributes such as:
  - Quantity
  - Make and model
  - Age
  - Location
  - Condition
- An inventory is limited by the data that are available, can be collected, and have utility for managing assets:
  - Not all available information has value for managing an asset
  - Too much information may make data management overly complicated

Why May an Agency Need an Inventory?

- Provides accurate data for TMS monitoring, evaluating, and reporting processes

- Yields key information about the agency's TMS assets, such as status, condition, performance, and needs

- Supports informed decisionmaking about assessing, managing, and operating TMS assets

- Feeds into various TMS planning activities, plans, and other processes throughout the lifecycle of the TMS

- Helps identify gaps in the current system and make decisions about asset maintenance and replacement

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What Resources Might an Agency Include in an Inventory of TMS Assets?

- Resources are non-physical assets that support management and operation of TMSs

- Including resources provides a more comprehensive view of the assets and supporting elements that make up the TMS

- Resources help agencies understand the full scope of what they have available to support effective TMS management and operation

- Resources support informed decisionmaking about resource allocation and use

- Resources ensure important supporting documentation and information on TMS are readily available when needed

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Example of TMS Assets and Resources to Inventory[1]

Assets

- CCTV cameras
- Traffic signals
- Traffic detectors
- Ramp meters
- Cabinets
- Controllers
- Databases
- Telecommunications subsystems
- Software applications
- Changeable message signs

Resources

- Policies affecting TMS assets
- Maintenance of operations contracts
- Standard operating procedures
- Maintenance processes documentation
- Device specifications and warranties
- Data sources
- Device configuration settings
- Work order details
- Software changelogs
- Device performance history

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Benefits of Creating an Inventory of TMS Assets[2]

- Supports effective management of TMS assets

- Informs planning for TMS improvements and day-to-day operations

- Facilitates efficient TMS asset maintenance and repairs

- Aids in procuring individual TMS elements

- Enables understanding of asset quantities, conditions, and age

- Supports obtaining resources to bolster TMS enhancements

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Current TMS Inventory Practices[2]

- When initiating a new inventory or updating an existing inventory, an agency may select asset attributes that help:
  - o Classify and define the assets
  - o Provide an understanding of performance and condition
  - o Support the activities that manage the assets
- When deciding to create an inventory or expand a current inventory, an agency may 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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Challenges With Creating an Inventory TMS Assets[1]

- Starting the effort and obtaining necessary resources

- Updating or enhancing the inventory through the course of time

- Maintaining inventory information and keeping it current

- Incorporating tasks to update the inventory as part of existing processes

- Sustaining the resources to support, manage, and maintain the TMS asset inventory

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Planning for a TMS Asset Inventory[1]

- Assess the type and quality of data available or that can be easily collected.

- Determine potential return on investment from creating—or updating and managing—an inventory of TMS assets.

- Evaluate the ability to integrate TMS inventory with other agency processes.

- Analyze the resource requirements for current inventory management and future inventory enhancements.

- Project ongoing resource needs for maintaining inventory information and system to collect, compile, and manage use.

- Plan for effective access and use of the inventory across the agency.

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Factors for Prioritizing TMS Assets and Resources to Inventory[1]

- Importance of assets to existing TMS operations

- Asset condition information for monitoring, maintenance, and repair

- Data collection effort and cost of TMS asset information

- Ongoing cost to maintain and update TMS asset information

- Anticipated application and value of TMS asset information

- Impact on future TMS planning and decisionmaking
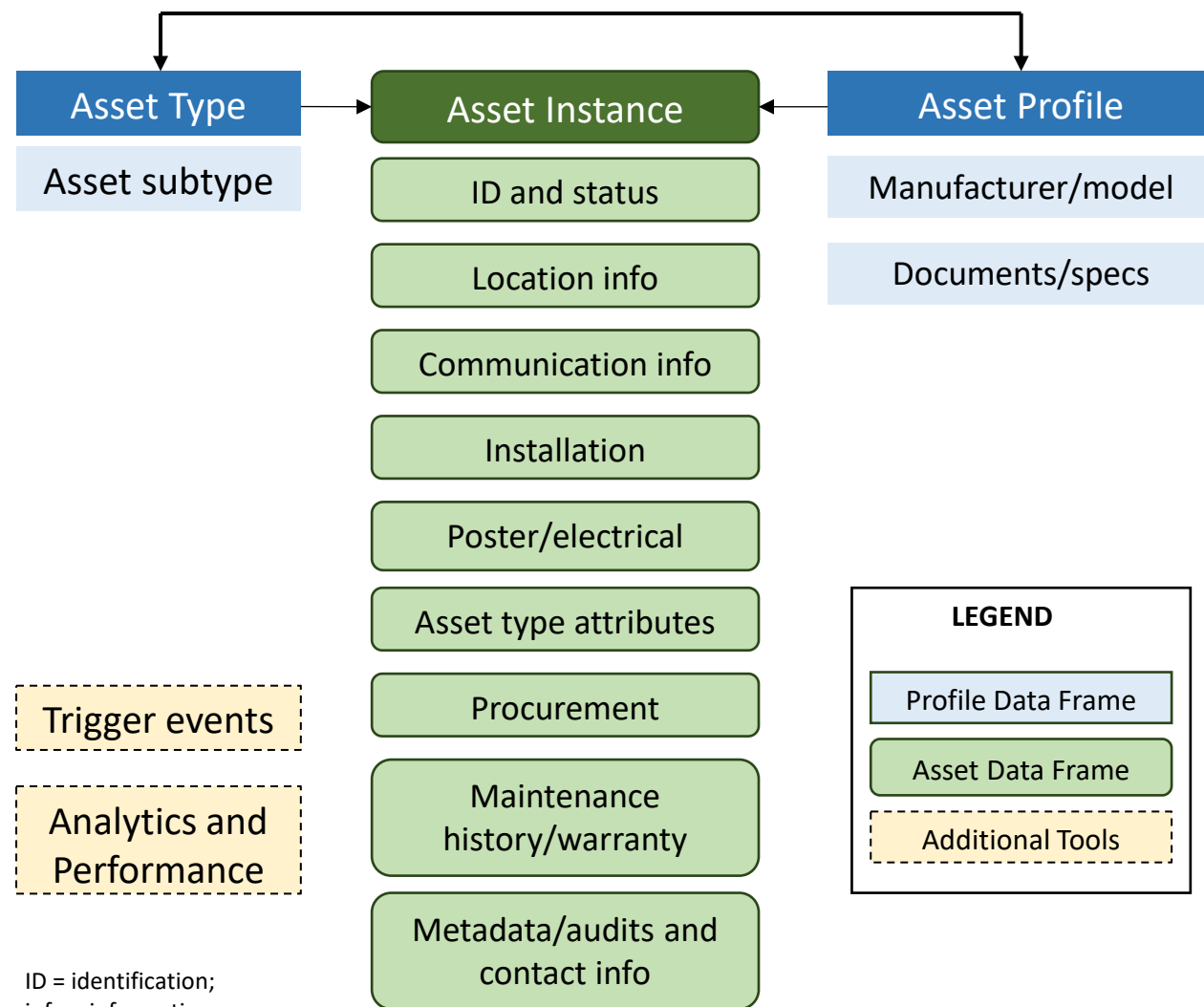
Example of Process to Select TMS Assets to Inventory

Input from agency executive leadership and decisionmakers

Input from asset managers, design, maintenance, and operations engineers

ASSET PRIORITIZATION

Conduct strategic review.

Prioritize assets into a tiered system.

DATA NEEDS

Define maintenance approach.

Identify data to support decisionmaking.

Optimize data collection.

DATA MANAGEMENT

Build information management for Infrastructure-agency data.

- Document process and methodology used (asset prioritization, data collection, data management).
- Form a data governance board to ensure consistency in data standards, policies, and procedures.
- Develop a data visualization platform (geographic information system, dashboards, data analytics) to help with financial planning and investment decisions.

Source: FHWA.[3]

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Considerations for Selecting TMS Assets to Inventory

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)

- 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)


Asset Type	Asset Instance	Asset Profile
Asset subtype	ID and status	Manufacturer/model
	Location info	Documents/specs
	Communication info	
	Installation	
	Poster/electrical	
	Asset type attributes	
	Procurement	
	Maintenance history/warranty	
	Metadata/audits and contact info	

Trigger events

Analytics and Performance

LEGEND

Profile Data Frame

Asset Data Frame

Additional Tools

ID = identification;
info = information;
specs = specifications.

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Classifying TMS Assets

- Categorize assets into logical groups such as hardware, software, or location

- Establish tiers based on operational importance or maintenance needs

- Use classification to prioritize data collection and maintenance efforts

- Apply consistent performance measures for assets in the same class

- Align classifications with intended use of inventory data

Source: FHWA.[4]

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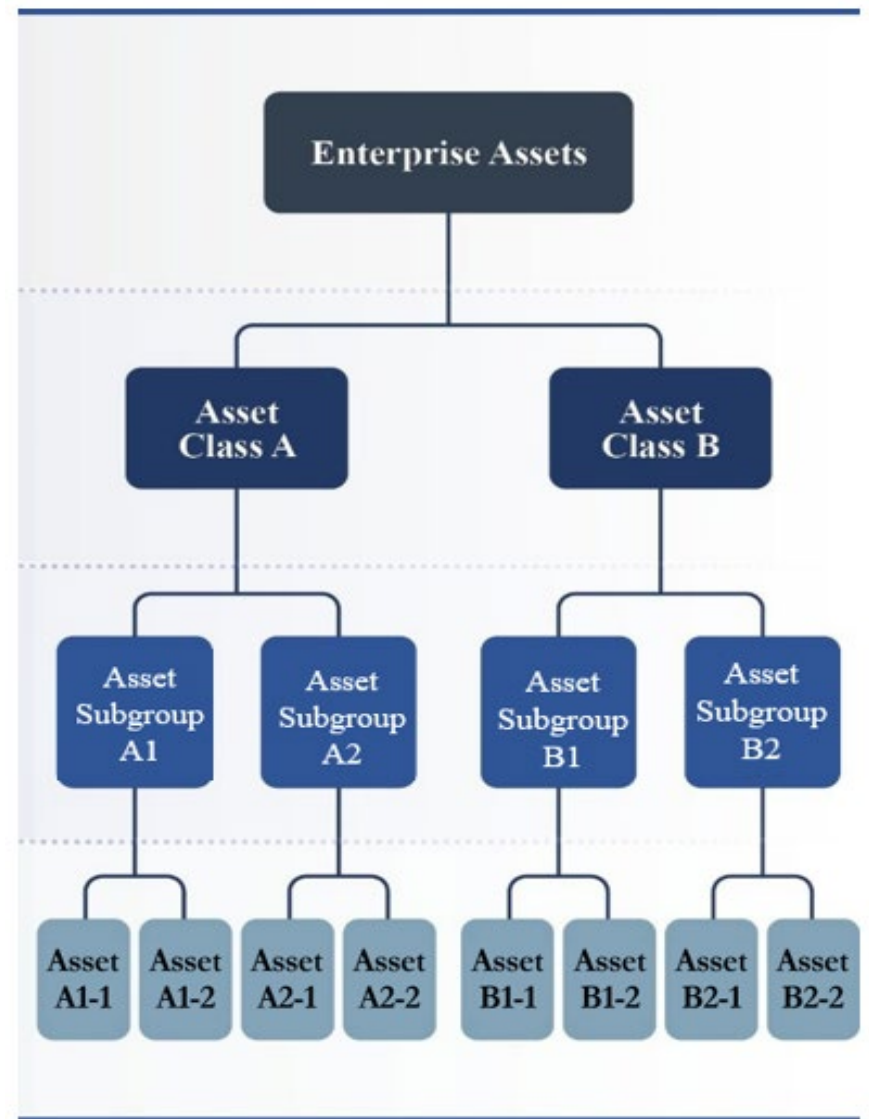
Considering TMS Asset Tiers[1]

Tiers reflect asset importance and maintenance priorities:

- Tier 1:
    - Asset is critical to system operations
    - Minimal downtime is acceptable
    - Asset has dedicated, prioritized funding
- Tier 2:
    - Asset is highly beneficial to system operations
    - Device is repaired within reasonable timeframes
- Tier 3:

    Asset downtime is not detrimental to system operations

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Example: TMS Asset Tiers[1]

TMS assets and resources grouped by importance, impact of downtime, and maintenance priorities.

Tier 1	Tier 2	Tier 3
• TMS servers • Database servers • Communication servers • Advanced traveler information servers • TMS software • Primary communication media • Vehicle detectors • Dynamic message signs • Primary communication hardware (e.g., layer 3 hub switches) • Over-height vehicle detection systems • Traffic signal controllers • Traffic signal heads and hardware • Device settings and configurations	• CCTV cameras • RWISs • Secondary communication media (e.g., branch fibers) • Video wall controllers • Video monitors and projection units • TMS workstations • Ramp meters	• Highway advisory radios • Weigh-in-motion stations • Emergency call boxes • Portable signs • Portable detectors • Portable cameras • Connected-vehicle onboard units and roadside units

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Selecting TMS Asset Attributes[1]

- Asset attributes capture unique characteristics for each TMS asset

- Attributes can be grouped by asset type, profile, and instance data:
  - Type: Categorical information such as component or subsystem
  - Profile: Shared characteristics such as make or model
  - Instance: Specific physical asset details such as ID or location

- Aligning attributes with asset tiers can help prioritize data collection

- Selection of attributes is based on value for asset management

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Considerations for Selecting TMS Asset Attributes

- Assess value of attributes for managing assets
- Prioritize attributes that inform maintenance, investments, and performance
- Evaluate costs of initial data collection and ongoing updates for each asset
- Implement quality control for data

- Example asset attributes:
  o Location
  o Installation date
  o Most recent service date
  o Asset condition
  o Functional description
  o Make and model
  o Serial number
  o Purchase cost
  o Maintenance costs
  o Firmware version

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Example TMS Assets' Attributes[5]

Area	Attribute	Field Devices	Communication and Networking	Hardware and Software	Portable
Inventory	Functional description	Y	Y	Y	Y
Inventory	Make and model	Y	Y	Y	Y
Inventory	Serial number	Y	Y	Y	Y
Inventory	Specifications	Y	Y	Y	Y
Inventory	Quantity	Y	Y	N	Y
Inventory	Components	Y	Y	N	
Inventory	Capital costs	Y	Y	Y	Y
Inventory	Contract and warranty	Y	Y	Y	Y
Inventory	Status	Y	Y	Y	Y
Location	Physical location	Y	Y	Y	N
Location	Physical environment	Y	Y	N	N
Location	Vehicle information	N	N	N	Y
History	Procurement date	Y	Y	Y	Y
History	Deployment date	Y	Y	Y	Y
History	Performance history	Y	Y	Y	Y
History	Maintenance history	Y	Y	Y	Y
History	Maintenance and operations costs	Y	Y	Y	Y
History	Condition	Y	Y	Y	Y
System environment	Software and firmware	Y	N	Y	Y
System environment	Hardware	Y	N	Y	Y
System environment	Licenses	Y	Y	Y	Y
Infrastructure	Infrastructure	Y	Y	N	N
Infrastructure	Utilities	Y	Y	N	N
Infrastructure	Enclosures	Y	Y	N	N

N = no; Y = yes.
Note: Gray cells indicate asset attributes not included in the inventory.

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Initiating an Effort to Create an Inventory of TMS Assets[1]

Items to consider when initiating an effort to create an inventory of TMS assets:

- Review existing asset information, inventories, or related data that could be expanded

- Determine inventory scope based on system size, complexity, and intended use

- Select TMS assets and resources to inventory

- Select TMS asset attributes to include

- Plan for data management, access, and maintenance responsibilities

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Reviewing Potential Existing Inventory Information

When reviewing potential existing inventory data or related information, an agency may consider the following example sources or systems:

- Enterprise asset management inventory:
  - A subset of TMS or intelligent transportation system (ITS) assets may already be incorporated.
  - The inventory is unlikely to be a thorough list of TMS assets.
- Existing spreadsheets of TMS asset information
- TMS databases containing TMS asset information
- Web-based software system tracking-device details

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Example of TMS Assets to Consider (1/2)[1]

When an agency is selecting assets to include in the TMS inventory, these are example assets to consider:

Asset Class/Asset Type	Asset Examples
Field devices/cameras	CCTV traffic cameras Video detection Camera: RWIS
Field devices/connected and automated vehicles	Roadside units Antennas
Field devices/highway advisory radios	Broadcast units
Field devices/message signs	Dynamic message signs Queue warning signs Blank-out signs Sign controllers Portable changeable message signs

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Example of TMS Assets to Consider (2/2)[1]

Asset Class/Asset Type	Asset Examples
Field devices/sensors	Traffic detectors Commercial vehicle dimension wireless data collectors Weigh-in-motion stations Roadway intersection conflict warning systems
Field devices/RWIS	Environmental sensing stations Non-invasive pavement sensors Road sensors
Field devices/traffic control	Controllers Gates Lane controllers Preemption signals Ramp meters Reversible lane signs Signals Variable-speed-limit signs Warning flashers Device settings and configurations
Field devices/traffic detection	Detectors

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Sustaining an Inventory of TMS Assets[1]

To sustain an inventory effort, an agency may consider:

- Maintaining inventory accuracy
- Managing impact on agency resources
- Integrating with existing processes
- Implementing ongoing quality assurance processes
- Updating inventory information during routine asset maintenance processes
- Providing easy access to historical asset information for operations and maintenance staff

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Resources to Consider for Sustaining a TMS Asset Inventory[1]

- Staff time to collect new asset information

- Staff time to manage the TMS asset inventory

- Staff or contractor time to maintain asset information through ongoing daily operations and maintenance efforts

- Staff time for quality assurance of inventory information

- Staff time to incorporate changes made to assets into the TMS asset inventory

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Managing the Use of Inventory Information[1]

- Multiple people entering data into the same inventory

- Data integrity, quality assurance, and quality control processes

- Update TMS asset data and information

- Assignment of clear responsibilities for inventory updates

- Establishment of a routine update schedule for inventory updates

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Maintaining TMS Inventory Accuracy[1]

- TMSs are constantly undergoing changes and upgrades

- TMS assets are frequently updated, replaced, or modified

- Maintaining inventory accuracy requires agency resources:

  o Assignment of data quality assurance and quality control responsibilities

  o Data governance practices

  o Interface management (tools for updating and controlling inventory data)

  o Regular audits of inventory information

- Without accurate inventory information, the benefits of an inventory are hindered

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Ensuring TMS Inventory Accuracy and Currency[1]

- Implement automated processes to capture and update inventory data:
  - o Integrate inventory updates into existing processes
  - o Leverage tools to streamline data entry and validation
- Establish regular audits and verification processes:
  - o Assign responsibilities for reviewing inventory data
  - o Conduct periodic checks for completeness and accuracy
- Document standard operating procedures for inventory management, with clearly defined roles, responsibilities, and processes

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Example Ensuring Inventory Accuracy: VDOT

- Virginia DOT (VDOT) uses randomly generated inventory reports to review asset inventories.[1]

- Five to 10 percent of inventoried assets are randomly selected.

- VDOT staff manually reviews asset information (e.g., location and status) and compares it with device information contained in the inventory).[2]

- Discrepancies are tracked and root causes mitigated when necessary.

- Processes are improved and maintained, which improves TMS inventory accuracy.

[1] Virginia DOT interview, 2021.
[2] Ibid.

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Assessing TMS Asset Inventory: Questions

- Evaluate existing TMS asset inventory practices:

  o   What assets are currently inventoried and in how much detail?

  o   How current and accurate is the existing inventory information?

  o   What processes are in place to keep the inventory up-to-date?

- Identify gaps and areas for improvement:

  o   Which critical TMS assets are not currently inventoried?

  o   What key information is missing for effective asset management?

- Use assessment insights to inform inventory planning and updates:

  o   Prioritize assets and data elements to add to the inventory

  o   Identify process changes needed to improve accuracy

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Opportunities to Create or Update an Inventory

- When completely replacing or upgrading a TMS, capture new asset details during TMS upgrades.

- When enhancing an existing TMS, document the new capabilities and components being added.

- As TMS assets get replaced or repaired, update asset records with maintenance details.

- When updating TMS-related processes or procedures, incorporate asset updates into revised processes.

Incorporating TMS Asset Information into TMS Operations[1]

- Incorporating inventory information during asset procurement

- Updating inventory information during routine asset maintenance processes

- Integrating device status alerts into ATMS software subsystems

- Providing easy access to historical asset information for operations and maintenance staff

Incorporating Inventory Practices into Agency Planning[1]

- Including TMS asset information in the agency's transportation asset management program or plan:
  - Including TMS assets in the enterprise inventory
  - Establishing TMS asset condition and performance targets
  - Incorporating TMS inventory into asset lifecycle planning
- Leveraging TMS inventory information for TMS program plan and process to allocate resources
- Including TMS inventory information in transportation systems management and operations program planning

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Opportunities to Use Inventory Information[1]

- Optimize TMS operations:
  o Expedite troubleshooting and repairs with access to historical data
  o Make informed decisions about routine actions on real-time asset status
  o Adapt quickly to events by integrating asset data into network monitoring
- Enhance maintenance and asset management:
  o Prioritize maintenance activities based on importance and condition
  o Identify trends and patterns in asset performance
- Support TMS planning and enhancements:
  o Analyze asset lifecycle costs and reliability to optimize replacement strategies
  o Justify funding requests, and prioritize projects based on asset needs
  o Identify integration requirements for new technologies

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Using TMS Inventory Information in Key Processes

- Maintenance and repair processes:
  - o Prioritize maintenance activities based on asset condition
  - o Automatically generate work orders when asset performance issues are identified
- Technology procurement and deployment:
  - o Identify outdated assets in need of replacement based on inventory data
  - o Evaluate compatibility of new technologies with existing system configuration
- System monitoring and performance reporting:
  - o Correlate asset condition with overall system performance metrics
  - o Document asset changes and impacts through the course of time
- Strategic planning and budgeting:
  - o Analyze asset lifecycle costs and failure rates to optimize refresh cycles
  - o Develop long-range plans accounting for asset dependencies and integration needs

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Inventory and Management of TMS Assets

Additional Resources

- The Evolution of ITS in Transportation Asset Management[5]

- Managing TMS Assets[2]

- Handbook for Including Ancillary Assets Transportation Asset Management Programs[3]

TMS Resources

- National Operations Center of Excellence TMS Portal[6]

- Transportation Management Center (TMC) Pooled-Fund Study website[7]

- Next Generation of TMS Resources[8]

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Questions?

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Speaker's Notes

Speaker's Notes (1/41)

This presentation aims to introduce the concept inventorying TMS assets and resources.

Speaker's Notes (2/41)

Table of contents with slide numbers for each topic covered in this presentation.

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Speaker's Notes (3/41)

A more detailed look, with examples, at a TMS structure

TMSs are comprised of multiple subsystems.

A subsystem is a group of self-contained and interactive components that support one or more operational strategies as a part of a TMS

The design or structure of a TMS can be broken down into its physical elements and its logical elements.

- The physical elements are the subsystem and the components.
- The logical elements are the operational strategies, functions, actions, and services.

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Speaker's Notes (4/41)

This technical presentation focused on establishing and using an inventory of TMS assets and resources. The activities involved with managing TMS assets on this diagram include:

- TMS Monitoring, Evaluating, and Reporting.
- Asset Identification and Classification.
- Asset Inventory.
- Asset Condition.
- Data Management.

Managing TMS assets improves the reliability of assets over time by reducing maintenance, repair, and overall costs of managing and operating the TMS. This understanding also supports agency decisions involving the management, operation, or planning to support justifying improvements and optimize agency investments in their TMSs.

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Speaker's Notes (4/41) (continued)

There are a range of activities conducted throughout the lifecycle of a TMS to effectively manage TMS assets. One of the key activities is developing, managing, and using an asset inventory. This involves several processes including:

- Preparing to manage TMS assets
- Managing TMS asset data, which includes TMS asset identification, classification, and inventorying
- Maintaining TMS asset data, which includes TMS asset condition rating, data maintenance, asset spare management, and managing the configuration of assets
- Monitoring, evaluating, and reporting on TMS assets

By following these processes to create and maintain a comprehensive TMS asset inventory, agencies establish a strong foundation for making well-informed decisions, effectively utilizing assets, and supporting long-term planning of their TMS.

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Speaker's Notes (5/41)

A TMS asset inventory is a comprehensive collection of information about the assets and resources that make up a Transportation Management System.

This inventory is designed to be dynamic, reflecting the most current information about each asset throughout its lifecycle.

The specific information included in a TMS inventory can vary between agencies, as each organization has its own unique needs and priorities.

Typically, a TMS inventory includes data on a wide range of components and devices, such as CCTV cameras, changeable message signs, and vehicle detection devices.

In addition to physical assets, a TMS inventory may also include resources like designs, specifications, plans, warranty documents, licenses, and agreements.

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.

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Speaker's Notes (6/41)

A well-maintained TMS asset inventory provides agencies with accurate data for monitoring, evaluating, and reporting on their Transportation Management System.

This inventory yields key information about the status, condition, performance, and needs of the agency's TMS assets.

By having access to this information, agencies can make informed decisions about assessing, managing, and operating their TMS assets effectively.

The data from a TMS inventory feeds into various planning activities, plans, and other processes throughout the lifecycle of the TMS.

For example, the inventory can help identify gaps in the current system during early planning phases, and support decisions about asset maintenance and replacement later in the lifecycle.

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Speaker's Notes (7/41)

When we talk about resources in the context of a TMS inventory, we're referring to a variety of non-physical assets that support the management and operation of the TMS.

These resources can include policies impacting TMS assets, maintenance of operations contracts, standard operating procedures, and maintenance processes documentation.

Other examples of resources to include in a TMS inventory are device specifications and warranties, data sources, work order details, software changelogs, and device performance history.

Including these resources in the inventory provides a more comprehensive view of the assets and supporting elements that make up the TMS.

By inventorying resources alongside physical assets, agencies can better understand the full scope of what they have available to support the effective management and operation of their TMS.

This information can help agencies make informed decisions about how to allocate and utilize resources, and how to align their TMS inventory with broader agency goals and objectives.

Including resources in the TMS inventory also helps ensure that important supporting documentation and information is readily available when needed, which can streamline processes and support effective decisionmaking.

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Speaker's Notes (8/41)

Examples of TMS assets commonly included in an inventory of TMS assets. Not an exhaustive list.

In addition to TMS Assets, some TMS Resources may also be useful to include in an inventory. Example resources to consider inventorying are shown here.

Value in inventorying both assets and resources: allows agencies to manage and maintain their TMS, monitor assets and report on their condition, manage TMS asset spares, plan for TMS enhancements, inform TMS or other agency planning efforts, and support active management and operation throughout the TMS lifecycle

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Speaker's Notes (9/41)

An inventory of TMS assets helps agencies keep track of and monitor their assets. The inventory provides valuable information that supports effective management and operation of the assets, leading to various benefits. For example, the inventory data can be used to understand asset quantities, conditions, and age, which can inform maintenance schedules, operational strategies, and long-term planning processes.

Speaker's Notes (10/41)

Agencies differ in how they manage their TMS assets and resources, with a particular focus on inventorying. Some agencies have already established an inventory, but they lack a comprehensive system for maintaining and using this information. For these agencies, the challenge lies in developing and implementing strategies to maintain their inventory and effectively use the information to manage and operate their TMS or support other processes.

On the other hand, other agencies may only have inventory information for some TMS assets and lack a complete inventory for all TMS assets. The challenge for these agencies is figuring out what may be appropriate or feasible to include, and how to initiate the process of creating an inventory of TMS assets and resources.

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Speaker's Notes (11/41)

Starting the effort requires gaining support from management, allocating staff and funding, and developing efficient configuration management processes.

The inventory needs to be continually updated and enhanced as the TMS components change over time. This requires adhering to defined processes and quality control.

Keeping the inventory information current demands incorporating documentation updates into existing agency processes like maintenance work orders. Agencies need to balance collecting sufficient information with avoiding overwhelming staff.

Getting staff to change how they work to maintain the inventory, especially early on, may face some resistance. Effective communication and stakeholder involvement is key.

Sustaining the resources, staff and funding to support the inventory long-term can also be difficult. Clearly communicating the benefits and assigning an inventory champion can help ensure ongoing support and success.

Speaker's Notes (12/41)

Each agency's considerations for planning or establishing inventory of assets will vary. Summary of considerations in this slide may be useful in the initial stages of the planning effort.

Speaker's Notes (13/41)

When prioritizing which TMS assets and resources to include in an inventory, agencies may consider several key factors:

- The criticality of each asset to the core functioning and operations of the current TMS is a top consideration. Assets that are essential to system performance are high priority.
- Asset condition information is crucial for effective monitoring, maintenance and repair activities. Prioritize assets where up-to-date condition info is needed.
- Agencies must weigh the level of effort and cost required to initially collect data for each asset type. Focus first on assets where data collection is feasible.
- The ongoing cost to continually maintain and update asset information over time must be factored in. Prioritize assets where ongoing data maintenance is sustainable.
- The anticipated value and specific applications of the asset information should guide the prioritization. Focus on assets where the data will be highly useful.
- Finally, consider the importance of each asset to future planning and decisionmaking regarding TMS enhancements. Prioritize assets that will inform long-term plans.

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Speaker's Notes (14/41)

Agencies may begin by reviewing what inventory data are already available, what additional information is needed, what additional assets and resources could be added, what information may be needed to manage a classification of assets, the resources needed to collect and maintain this information, and available resources to update or collect the needed data. This graphic presents a high-level framework for prioritizing what to include as part of an inventory of TMS assets and resources.

Speaker's Notes (15/41)

While ideally an agency would capture all of their TMS assets and resources in an inventory, resource constraints often necessitate prioritizing a subset of the total assets to inventory.

Agencies may benefit from focusing on covering the most critical assets to ensure the inventory data is accurate, complete and up-to-date. Trying to cover too many assets with limited resources risks compromising data quality.

The subset of assets selected for the inventory can include those that are essential to the active management and operation of the TMS. These are the assets where having readily available data in the inventory will be most beneficial day-to-day.

Additionally, assets can be captured where the inventory information will support key activities like system maintenance and repair. For example, including maintenance history on dynamic message signs.

To help with maintaining inventory accuracy over time, look for opportunities to incorporate inventory update tasks into existing agency processes, like adding it to maintenance work order closeout.

For the selected assets, ensure there is a clear plan laid out for the initial data collection as well as the ongoing maintenance of that data. Assign roles and responsibilities to avoid data becoming stale.

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Speaker's Notes (16/41)

Classifying TMS assets is a crucial step in creating an inventory that supports asset management and decisionmaking. Key considerations include:

Categorizing assets into logical groups such as hardware vs software, field devices vs central systems, etc. This allows for aggregation and comparison of like assets.

Establishing tiers that reflect each asset's criticality to TMS operations, tolerance for downtime, and priority for maintenance and funding. Tiers help prioritize resource allocation.

Using the classification scheme to guide data collection efforts and ongoing maintenance of the inventory data. Focus on the high-priority, high-value asset classes.

Applying consistent performance measures and targets for assets within the same tier or class. This enables tracking and reporting asset performance at the class level.

Aligning classification approaches with the intended applications of the inventory data, such as maintenance budgeting or replacement planning.

A well-designed asset classification system is foundational to an effective TMS asset inventory.

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Speaker's Notes (17/41)

Building on the concept of asset classification, many agencies establish tiers that define each asset's importance and priority. Typical/sample tier definitions may include:

- Tier 1 assets are critical to core TMS operations. Minimal downtime can be tolerated and these assets receive dedicated funding. Example: central servers.
- Tier 2 assets are highly beneficial to operations. Repairs are completed within reasonable, but not immediate, timeframes. Example: CCTV cameras.
- Tier 3 assets provide value but temporary downtime is not detrimental to overall TMS functionality. These are repaired or replaced as needed. Example: call boxes.

Tiers provide a valuable framework for TMS planning and decisionmaking. Agencies can use the tiers to:

Inform preventive maintenance strategies, establishing frequency and scope of maintenance activities by tier.

Prioritize investments, focusing limited funds on Tier 1 and 2 assets.

Provide context for performance measures, tracking and reporting asset uptime, performance and condition by tier to identify problem areas.

By aligning TMS asset management practices with a tiered classification scheme, agencies can more effectively allocate resources and make data-driven decisions to sustain system performance.

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Speaker's Notes (18/41)

More detailed example of how TMS Assets may be tiered

Example of assets grouped into 3 tiers considering:

- Criticality
- Impact on operations
- Downtime impact
- Maintenance priorities

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Speaker's Notes (19/41)

Asset attributes provide the foundation for an effective TMS asset inventory. Each asset has a range of attributes that describe its unique characteristics and support various asset management activities.

Attributes can be grouped into categories such as:

- Asset type: high-level categorical information
- Asset profile: characteristics shared by assets of the same make/model
- Asset instance: data specific to an individual physical asset

Aligning the selection of attributes with the established asset tiers allows agencies to prioritize data collection efforts. The most critical, highest tier assets warrant collecting a more extensive set of attributes.

When determining which attributes to include in the inventory, agencies should consider the value of each attribute for supporting asset management and decisionmaking. Attributes that inform maintenance strategies, investment planning, and performance reporting should be prioritized.

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Speaker's Notes (20/41)

Agencies face important considerations and potential challenges when selecting the specific attributes to include in their TMS asset inventory.

A key factor is the value each attribute provides for effectively managing the assets and supporting overall TMS operations. Attributes that yield actionable insights should be prioritized.

The costs of collecting data for each attribute should be weighed against the expected benefits. This includes both the initial data collection and the ongoing effort to keep the attribute data current.

Agencies should consider how frequently each attribute will be used and for what specific purposes. Attributes that directly inform critical asset management decisions warrant greater investment.

Implementing quality control procedures is essential to ensure the consistency and accuracy of attribute data. This may involve data validation, standardized naming conventions, and secure access controls.

Agencies can often leverage existing processes, such as maintenance work order systems, to streamline attribute data collection and updates. Modifying these processes to sync with the inventory can greatly improve efficiency and data quality.

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Speaker's Notes (21/41)

Potential asset attributes to include. Source: Enterprise Pool Fund

Note: gray highlight indicates asset attributes not included in the inventory

Speaker's Notes (22/41)

- Resource Justification: Explain the importance of obtaining and justifying resources for the inventory effort.
- Inventory Scope: Discuss factors influencing scope, such as system complexity and data usage.
- Organizational Alignment: Emphasize aligning the inventory with broader goals and plans.
- Data Considerations:
  - Explain how asset condition information supports TMS management and operations.
  - Discuss stakeholder access and usage of asset data.
  - Mention how data supports maintenance and repair activities.
- Tool Selection: Suggest choosing inventory tools that align with organizational objectives.
- Data Management: Address data retention policies, quality assurance, and maintenance responsibilities.
- Implementation Approach: Stress the importance of balancing comprehensiveness with practicality to avoid burdensome processes.

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Speaker's Notes (23/41)

Any existing records or information can serve as a starting point for identifying what information may be applicable to consider including in an inventory of TMS assets and resources.

There may be existing records containing information about TMS assets. Any records approximating an inventory of different TMS assets may be appropriate to review and consider with any effort to initiate developing a TMS inventory.

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Speaker's Notes (24/41)

A more detailed table of example assets an agency may consider including in their TMS asset inventory.

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Speaker's Notes (25/41)

A more detailed table of example assets an agency may consider including in their TMS asset inventory (continued).

Speaker's Notes (26/41)

Moving on from initiating an inventorying effort.

Now discussing things to consider with sustaining an inventorying effort.

Each of these bullet points will be discussed further in the slides that follow.

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Speaker's Notes (27/41)

To sustain a TMS asset inventory, staff time and resources are needed to integrate inventory maintenance steps into existing agency processes. Agencies may need to review their budget, staff resources, tools, or services (e.g., support contracts) available to support maintaining and managing their asset and resource inventories.

Speaker's Notes (28/41)

Potential or common challenges with inventorying TMS assets and suggested mitigations shown in notes:

- Traditional relational databases are difficult to maintain, especially older versions
  Consider using a multi-user asset management tool that leverages a modern backend database

- Process for multiple jurisdictions to perform data entry into a common tool
  Research potential tools that meet multi-user requirements to encourage tool sharing

- Setting update schedule and following through/enforcement
  Ensure data are kept accurate and up to date in a timely fashion

- Data integrity, QA/QC
  Establish QA/QC processes to verify data accuracy, and use drop-down menus for data entry where possible to standardize data entry

- Incentivizing and prioritizing
  Emphasize the importance of data completeness and accuracy

- Assigning responsibilities
  Create ownership of each step of the process

- Inconsistent definition of assets
  Develop consistent and agreed-upon definitions

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Speaker's Notes (29/41)

TMSs are complex and integrated systems that are constantly undergoing changes and upgrades. Individual TMS assets and resources are frequently updated, modified, repaired, or replaced, which increases the complexity of the TMS. Having an up-to-date inventory of TMS asset and resources supports the agency with maintaining, repairing, assessing, managing, and reporting on the performance of TMSs.

Speaker's Notes (30/41)

To maintain the accuracy and currency of the TMS asset inventory over time, agencies should consider implementing a range of ongoing quality assurance processes.

Automating data capture and updates can greatly improve inventory accuracy while reducing manual effort. Look for opportunities to integrate inventory updates into existing workflows, such as maintenance work orders or procurement processes. Leveraging tools that streamline data entry and validation can also help maintain data quality.

Establishing a regular audit and verification process is critical for catching and correcting any errors or omissions in the inventory data. Assign clear responsibilities for reviewing the inventory on a periodic basis, and conduct targeted checks for key data elements.

Monitoring and reporting on inventory status and metrics can help ensure the inventory remains a focus and priority for the agency. Track key performance indicators that provide visibility into the health and accuracy of the inventory, and share updates and insights with stakeholders to maintain engagement and support.

Finally, documenting standard operating procedures for all inventory management processes is essential for consistent execution. Clearly define roles, responsibilities, and step-by-step processes for each inventory-related task. Provide training and quick reference resources to ensure all staff have the knowledge and tools they need to contribute to maintaining an accurate and up-to-date inventory.

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Speaker's Notes (31/41)

None.

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Speaker's Notes (32/41)

Before creating a new TMS asset inventory or updating an existing one, it's important for agencies to assess their current inventory practices and identify opportunities for improvement.

Key elements of this assessment include:

- Evaluating the current state of the inventory, including what assets are captured, the level of detail available, and the accuracy and currency of the information
- Examining existing processes for updating and maintaining the inventory to identify any gaps or weaknesses

The assessment should also identify critical gaps in the current inventory, such as:

- TMS assets that are not currently captured but should be
- Key data elements that are missing but are needed for effective asset management and decisionmaking
- Limitations in the accessibility and usability of the inventory data for stakeholders

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Speaker's Notes (32/41) (continued)

Agencies can then use the insights from this assessment to inform their planning for creating or updating the TMS asset inventory. Specific applications include:

- Prioritizing which assets and data elements to add to the inventory based on their criticality and the gaps identified
- Proposing process changes to address weaknesses in inventory updating and maintenance, improving currency and accuracy
- Planning for the tools, resources, and organizational changes needed to expand and maintain a robust TMS asset inventory over time

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Speaker's Notes (33/41)

There are several key opportunities for an agency to initiate the process of creating a new TMS asset inventory, updating an existing inventory, or adding new TMS assets into the tracking system. These include:

When completely replacing or upgrading a TMS: Take advantage of the TMS refresh to capture comprehensive details on all new assets being deployed. Integrate asset data collection into the upgrade process.

When enhancing an existing TMS: As new capabilities or components are added to the TMS, systematically document and add these to the inventory. Establish processes to ensure any enhancements are reflected in the asset records.

As TMS assets are replaced or repaired: Leverage maintenance and replacement activities to update individual asset records with details on service history, parts replaced, and asset condition. Work order closeout is a natural point to capture this data.

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Speaker's Notes (33/41) (continued)

When creating new TMS plans or processes: Use the development of new plans as an opportunity to define what asset data may be collected and how it will be maintained. Integrate these requirements into the planning deliverables and process designs.

When updating TMS-related processes or procedures: Look for ways to incorporate asset data collection or updates into any revised standard operating procedures. Make asset management activities a standard part of recurring workflows.

By taking advantage of these opportunities to systematically create or update the TMS asset inventory, agencies can spread the workload across ongoing activities and ensure the inventory is being continuously refreshed. The key is to plan ahead for how asset management can be made a standard part of TMS upgrades, maintenance, and planning efforts.

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Speaker's Notes (34/41)

Example integrations of inventorying practices into day-to-day operations to leverage the asset inventory data and maintain the inventory information accuracy.

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Speaker's Notes (35/41)

Opportunities to leverage TMS inventory information for agency planning processes.

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Speaker's Notes (36/41)

The true value of sustaining a TMS asset inventory lies in the ability to leverage that information to manage and improve TMS operations and asset conditions. Some key opportunities to use inventory information include:

Optimizing TMS operations by expediting troubleshooting with access to historical asset data, making informed decisions based on real-time asset status, and adapting quickly to events by integrating asset data into network monitoring processes.

Enhancing maintenance and asset management activities by prioritizing work based on asset criticality and condition, identifying performance trends to guide investments, and streamlining work order processes with ready access to detailed asset information.

Supporting TMS planning and enhancement efforts by analyzing asset lifecycle costs and reliability to optimize replacement strategies, justifying funding requests based on quantified asset needs, and identifying compatibility requirements for integrating new technologies.

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Speaker's Notes (36/41) (continued)

To realize these benefits, agencies must ensure the inventory information remains accurate and up-to-date. This requires establishing clear processes and responsibilities for data quality management, including regular validation, well-defined update workflows, and automated data collection and integration wherever possible.

By putting TMS asset inventory information to use in these ways, agencies can achieve tangible improvements in system performance, resource allocation, and long-term planning. The key is to treat the inventory as a dynamic tool that is actively leveraged to drive decisions and actions across all aspects of TMS management and operations.

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Speaker's Notes (37/41)

To maximize the value of a TMS asset inventory, the information it contains can be actively leveraged in key agency processes related to managing and operating the TMS. Some prime opportunities include:

Maintenance and Repair Processes: Use inventory data on asset criticality and condition to prioritize maintenance activities. Set up automated work order generation when asset performance issues are detected. Ensure asset records are updated with service history during work order closeout.

Technology Procurement and Deployment: Consult the inventory to identify outdated assets in need of replacement. Evaluate the compatibility of new technologies with the existing system configuration. Capture full details on newly deployed assets in the inventory during the commissioning process.

System Monitoring and Performance Reporting: Correlate asset condition data with overall TMS performance metrics to identify problem areas. Use the inventory to flag assets nearing end-of-life for proactive replacement planning. Document configuration changes and assess their impacts over time.

Strategic Planning and Budgeting: Analyze historical asset lifecycle costs and failure rates to optimize technology refresh cycles. Use quantified asset condition data to justify investment needs and prioritize funding requests. Develop long-range TMS plans that account for asset dependencies and integration requirements identified via the inventory.

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Speaker's Notes (38/41)

None.

Speaker's Notes (39/41)

None.

Speaker's Notes (40/41)

None.

Speaker's Notes (41/41)

None.