Documenting and Configuring a Traffic Management System (TMS) Inventory

Transportation Management Center (TMC)

Pooled-Fund Study[1]

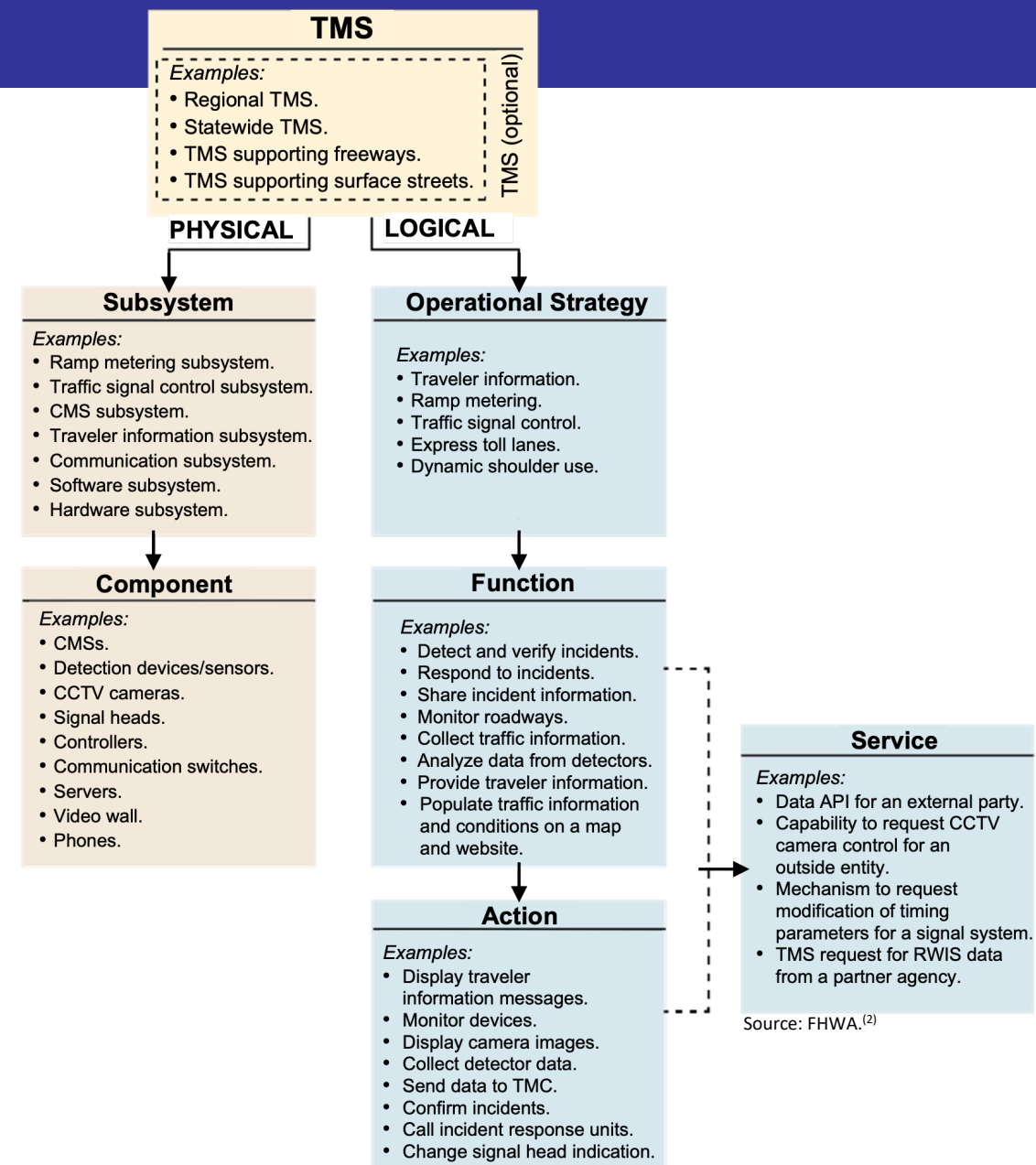**Federal Highway Administration (FHWA)**

November 2024

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TMS Elements

TMS design and structure can be broken down into physical elements and logical elements:

- Physical elements include the subsystem and components.

- Logical elements include the operational strategies, functions, actions, and services.

Source: FHWA.[2]

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; the dashed lines show the need for connection to external systems.

Managing TMS Assets

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

- Preparing to manage TMS assets.

- Managing TMS asset data, including identifying, classifying, and inventorying.

- Maintaining TMS asset data, including condition rating, data maintenance, asset spare management, and asset configuration management.

- Monitoring, evaluating, and reporting on TMS assets.

Source: FHWA.[3]

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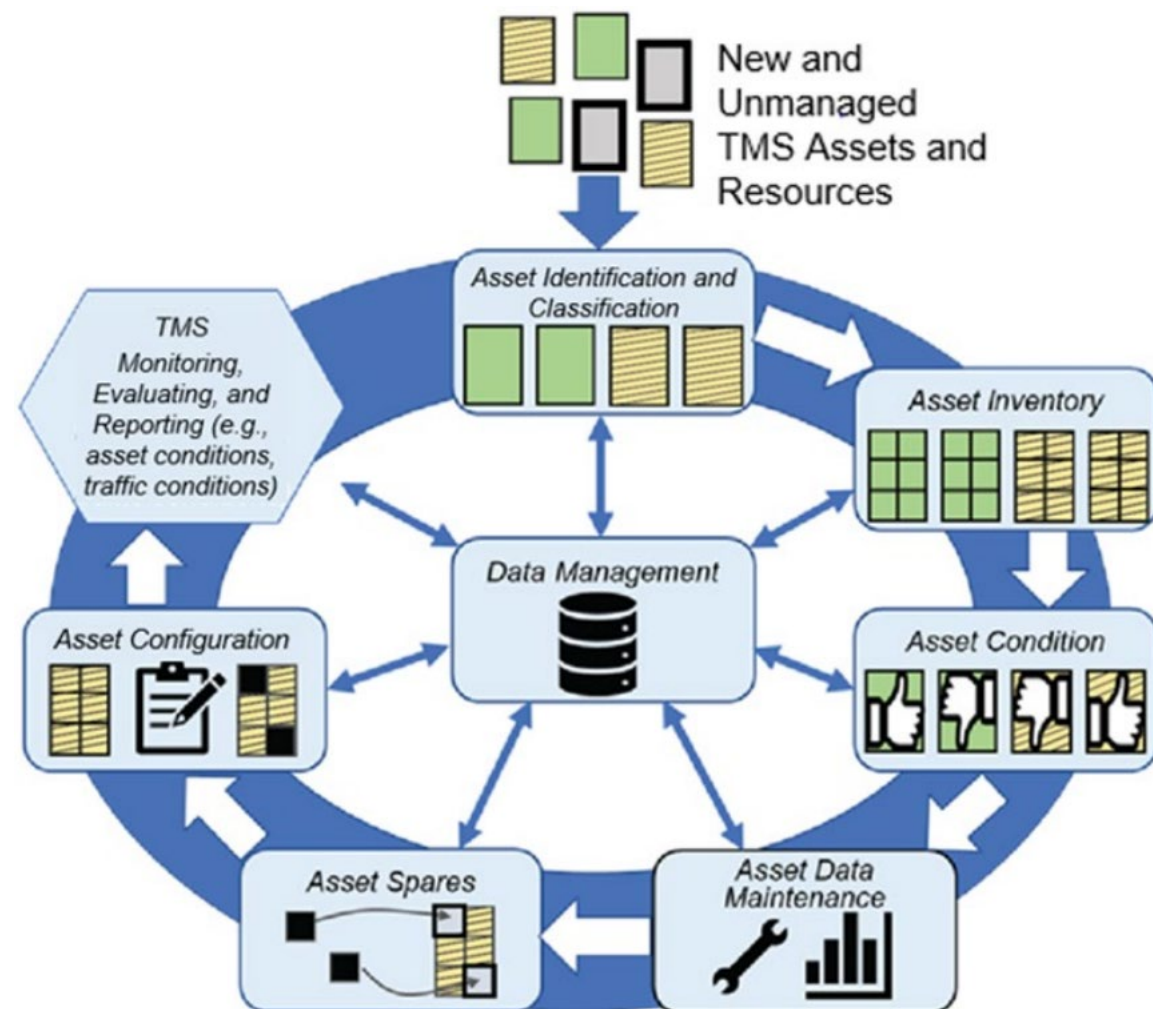
Benefits of Managing TMS Assets

- Monitoring, managing, and reporting on TMS asset condition.

- Achieving and sustaining a state of good repair for managed TMS assets.

- Managing TMS asset lifecycles to achieve desired performance with lower overall costs.

- Improving the performance of TMS assets and the overall TMS.

- Integrating the condition of TMS assets and resources into how they are managed, maintained, repaired, replaced, and operated.

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.

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Value of a TMS Asset Inventory

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

- Yields information about TMS assets, such as status, condition, and performance.[4]

- 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.

- Supports procuring individual TMS elements.

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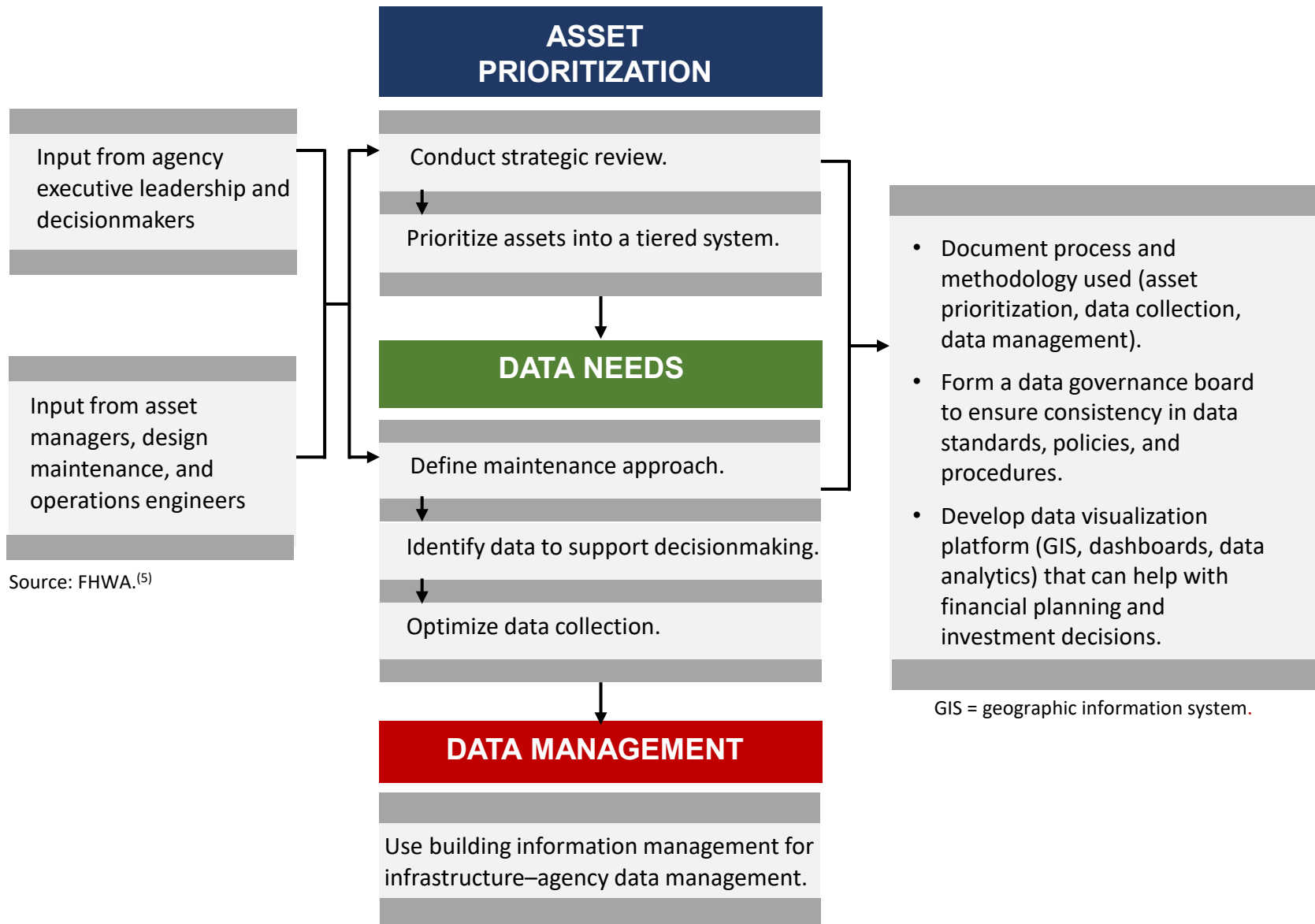# Initiating and Sustaining an Inventorying Effort

Initiating the effort:

- Review existing asset information or existing inventories.

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

- Select TMS assets and resources to inventory.

- Select TMS asset attributes to include.

- Determine how and where inventory information is collected and stored and what resources are needed.

Sustaining the effort:

- Maintain inventory accuracy.

- Analyze impact on agency resources.

- Integrate with existing processes.

- Ensure ongoing quality assurance processes.

- Leverage inventory information.

- Update inventory information during routine asset maintenance processes.

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Process To Select TMS Assets To Inventory: Example Flowchart

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

Use building information management for infrastructure–agency data management.

Input from agency executive leadership and decisionmakers

Input from asset managers, design maintenance, and operations engineers

Source: FHWA.[5]

- 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 data visualization platform (GIS, dashboards, data analytics) that can help with financial planning and investment decisions.

GIS = geographic information system.

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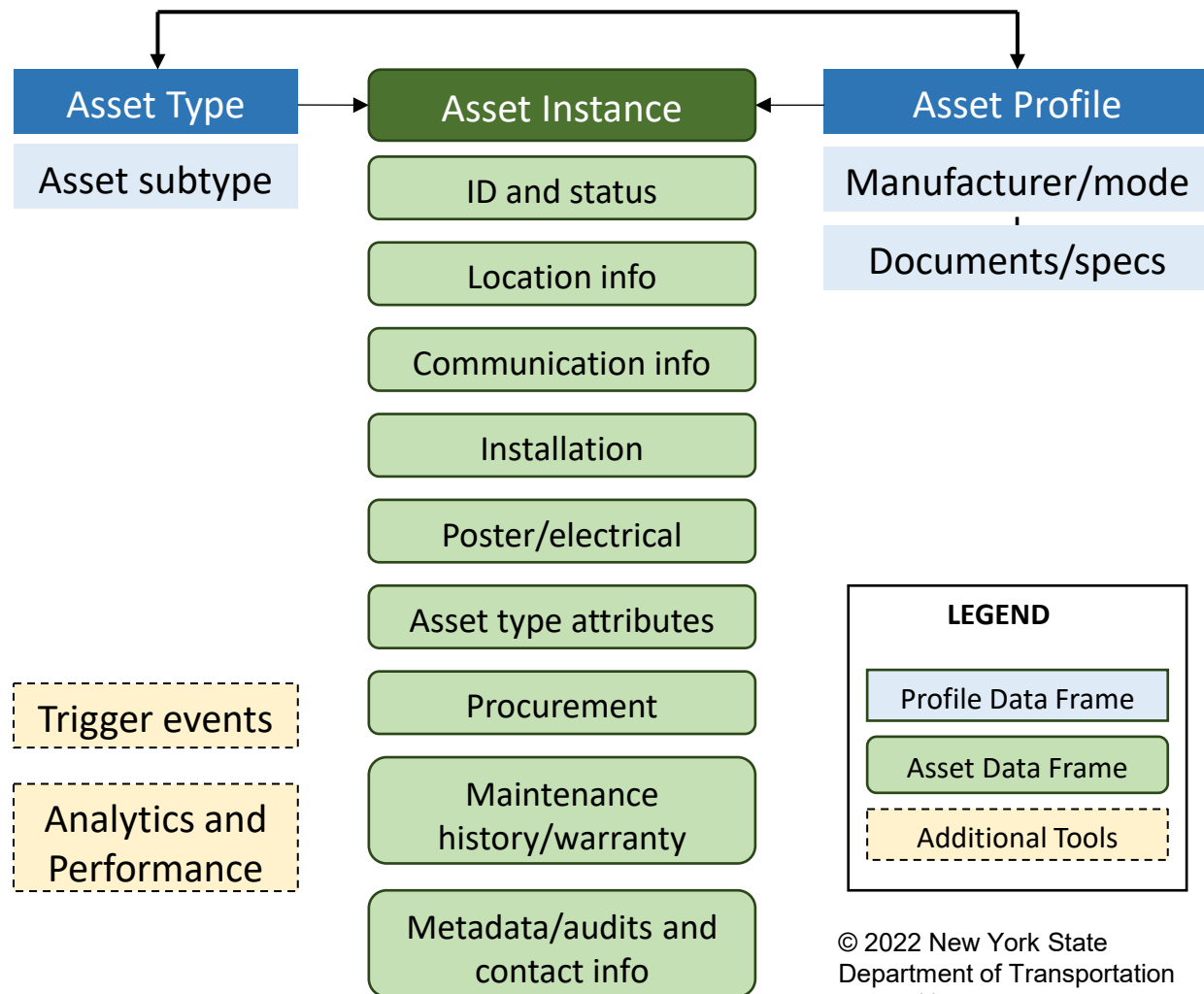**Federal Highway Administration**

Considerations in Selecting TMS Assets To Inventory

Example framework for defining asset inventory:

- Asset type—Correlates with 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—Includes 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

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

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Challenges in Inventorying TMS Assets

- Starting the inventorying effort and obtaining necessary resources.

- Updating or enhancing the inventory over time.

- Maintaining inventory information and keeping it current.

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

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

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Documenting TMS Assets and Resources

Documenting is the capture, management, and maintenance of TMS asset information and resources. This process includes recording changes in the inventory as devices are:

- Maintained.
- Serviced.
- Upgraded.
- Reconfigured.
- Removed.

Benefits of Documenting TMS Assets

- Accessing and using documents (e.g., specifications, request for proposal, contract, plans, vendor or contractor warranty) for more informed decisionmaking.

- Accessing warranty support throughout the asset's lifecycle.

- Maintaining a centralized inventory of documentation to create better historical records and knowledge sharing.

- Accessing comprehensive documentation to improve processes for overall TMS performance.

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Examples of TMS Inventory Documentation

- Saving and inventorying requirements, specifications, and documents used for selecting, obtaining, and installing assets.

- Capturing delivery documentation, such as invoices, shipping information, and validation of the asset's condition on receipt.

- Recording installation details, including testing, acceptance, connections established, and postinstallation inspection.

- Documenting service orders or tickets to the asset inventory's historical record, including personnel involved, dates, actions taken, parts replaced, and photographs.

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Challenges in Documenting Inventory of TMS Assets (1/2)

- Designing and implementing processes and tools to add documented information to a TMS asset inventory.

- Establishing procedures for updating documentation as part of regular maintenance and upgrade activities.

- Coordinating with other sources and users of documentation.

- Managing varying practices and expectations or disparate storage locations.

- Handling inadequate integration between existing documentation storage and inventory systems.

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Challenges in Documenting Inventory of TMS Assets (2/2)

- Maintaining accurate work order logs and documentation.

- Supplementing insufficient documentation of practices or expectations.

- Finding alternative information when key documentation for TMS assets is missing.

- Providing documentation and version control to maintain integrity of asset information.

- Assigning clear roles and responsibilities for documentation tasks and providing adequate staff training.

- Incorporating access to TMS asset inventory across multiple systems and platforms to ensure documentation is accessible and consistent.

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Configuration Management To Support a TMS Asset Inventory

- Configuration management is a series of processes and procedures that support system integrity (configuration identification, change management, configuration status accounting (CSA), configuration audits).[5]

- Configuration management practices are directly applicable to establishing and maintaining a TMS asset inventory.

- Configuration management's integration into existing agency processes provides a framework for effective TMS asset inventory management.

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Benefits of Configuration Management for TMS Asset Inventories

- Improves inventory accuracy and reliability through well-defined processes.

- Enables unique identification and tracking of individual assets in the inventory.

- Creates uniform identifiers for assets across tools and resources.

- Provides historical record of asset changes.

- Verifies TMS assets are as expected or identifies how assets have changed.
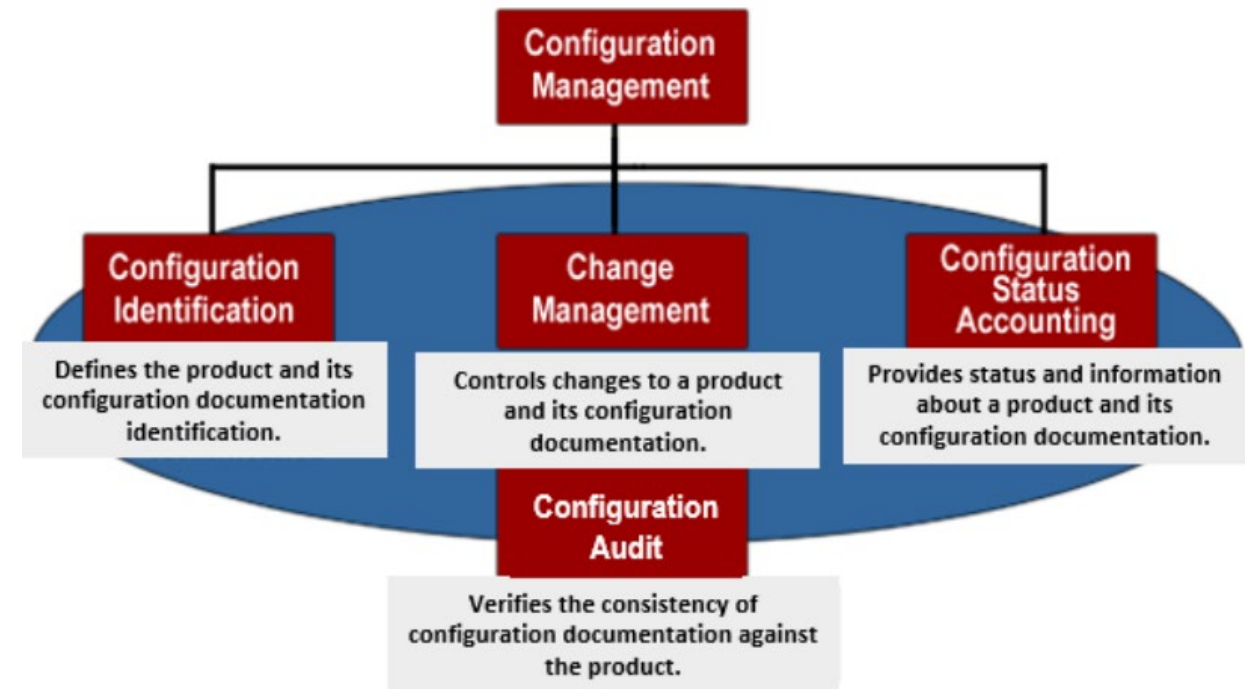
- Enhances integration of asset information with other systems and processes.

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Configuring TMS Asset Information

- Hardware component versions (detectors, signal heads, communication devices).

- Software versions (date installed, warranty information, vendor or maintenance support, user manuals).

- Asset maintenance details (date installed, maintenance dates, repairs performed).

- Asset configuration history (change logs, version numbers, debugging information).

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TMS Asset Configuration Management Processes

- 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.

Configuration Management

Configuration Identification
Defines the product and its configuration documentation identification.

Change Management
Controls changes to a product and its configuration documentation.

Configuration Status Accounting
Provides status and information about a product and its configuration documentation.

Configuration Audit
Verifies the consistency of configuration documentation against the product.

Source: FHWA.[3]

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Uniquely Identifying Assets for Inventory Management

- Defining an asset identification scheme.

- Assigning unique identifiers to all assets to track all changes over time.

- Tracking inventory consistently.

- Linking all changes to specific assets.

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Managing TMS Asset Configuration Changes

- Assessing the impact of a possible system change:

  o Affect on asset.
  o Affect on entire system.

- Deciding whether to approve a change (via change control board).

- Tracking and documenting changes made (configuration) if changes are approved.

- Documenting and tracking changes within the TMS asset inventory.

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Asset Configuration Status Accounting

- Ensuring all documentation and change history information is up to date for the asset's entire lifecycle.

- Providing access to current configuration information.

- Improving TMS asset data quality and data governance by tracking changes to individual asset components.

- Enhancing the reliability of inventory information for TMS management activities.

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Configuration Audits To Verify a TMS Asset Inventory

- Analyzing and verifying asset configuration and documentation within the TMS asset inventory.

- Preventing and correcting inaccurate documentation.

- Verifying routine audits and any recent changes.

- Adding an additional layer of quality for inventory management.

Benefits of Integrating Documentation Into TMS Operations

- Supports agency planning and allocation of resources.

- Enables routine system maintenance, repairs, and enhancements.

- Facilitates managing TMS assets and supporting activities.

- Helps establish and track asset performance measures and targets through data-driven insights.

- Enables more accurate preventive maintenance scheduling and deterioration modeling based on documented system history.

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Strategies for Keeping Documentation Current

- Use maintenance ticketing systems to update documentation.

- Integrate new device information automatically.

- Link TMS asset inventory to documentation.

- Adopt technologies that support easy updates.

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Integrating Configuration Management Into TMS Operations

- Develop a configuration management plan aligned with operational needs and procedures.

- Establish policies and procedures for controlling system changes.

- Define clear roles and responsibilities for configuration management.

- Integrate configuration management into system enhancement planning.

- Incorporate maintenance, repairs, and asset replacements into the configuration management process.

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Leveraging Configuration Management in System Enhancements

- Incorporate configuration management into planning for potential TMS improvements.

- Document system changes and impacts on existing configurations.

- Capture configuration updates in centralized documentation.

- Verify configurations through audits after system changes.

- Integrate configuration management practices throughout the lifecycle of new assets and improvements.

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Asset Documentation Example

This screenshot shows a Georgia DOT (GDOT) graphical depiction of asset documentation displayed on a TMS dashboard.

© 2020 GDOT. Original map © 2020 Mapbox © OpenStreetMap. Modified by GDOT.[6,7]

Asset Configuration Example

This flowchart shows New York State DOT (NYSDOT) example asset attribute classifications. These classifications form a foundation for tracking asset configurations and changes over time, including any changes to:

- Location information.
- Maintenance history.
- Communication information.
- Metadata.
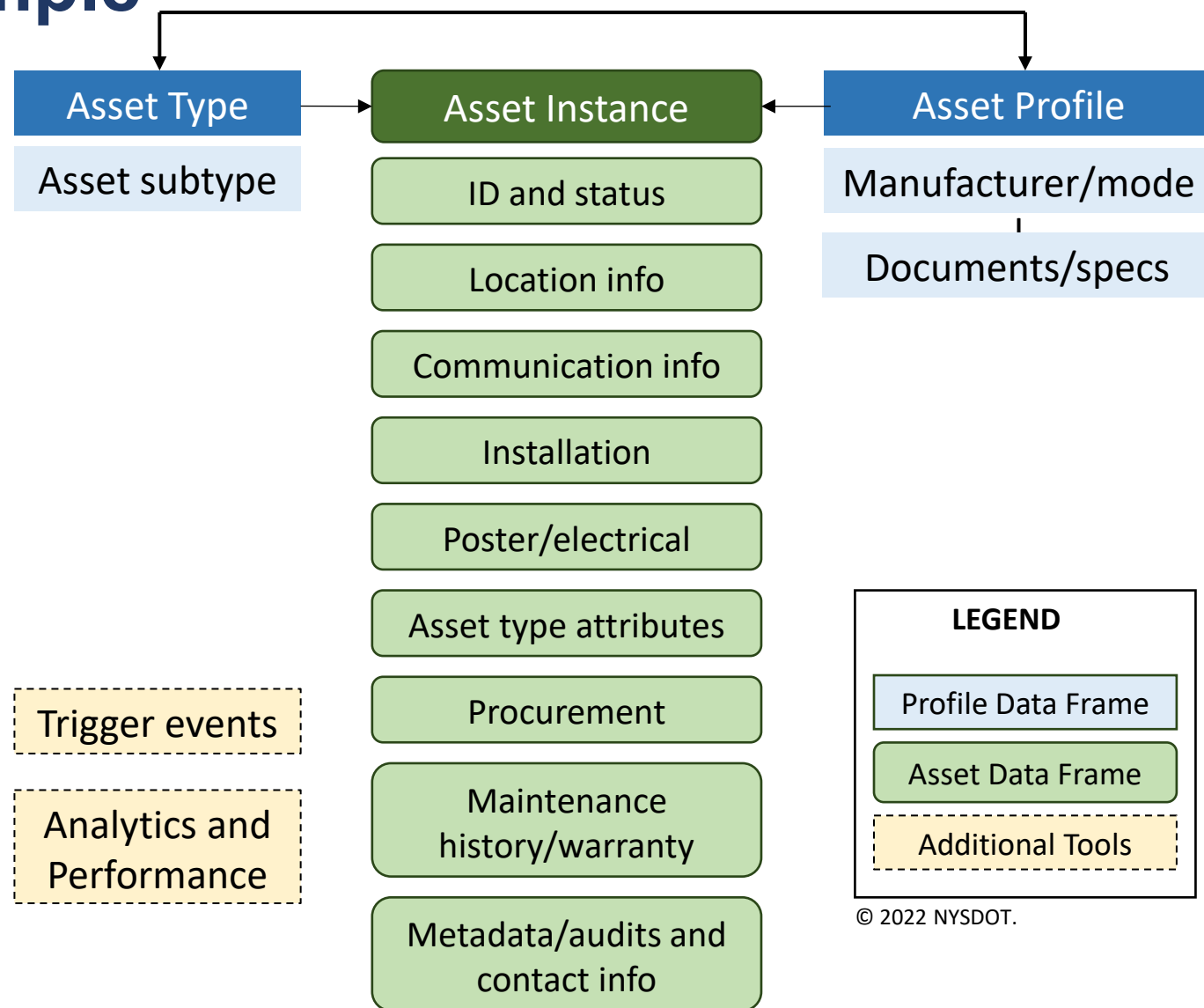
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TMS Asset Inventory Documentation and Configuration: Current Practices

- Focusing on essential assets and documentation only.

- Ensuring data quality and accuracy.

- Evolving and adapting procedures for continued relevance.

- Managing resources and tools.

- Communicating the importance and impact of these practices to staff.

- Incorporating these practices into the day-to-day activities of managing and operating a TMS.

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TMS Resources

- National Operations Center of Excellence (NOCoE) TMS portal.[8]

- TMC Pooled Fund Study website.[1]

- Managing Traffic Management System Assets. [3]

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