NORTH/WEST PASSAGE

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Asset Management Practices for ITS Infrastructure

Project 12.6

Prepared by: Athey Creek Consultants

North/West Passage

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1. INTRODUCTION

The North/West Passage (NWP) pooled fund program focuses on cross-border intelligent transportation systems (ITS) coordination along the I-90 and I-94 corridors through the states of Washington, Idaho, Montana, Wyoming, North Dakota, South Dakota and Minnesota, as illustrated in **Figure 1**.

Figure 1: North/West Passage Members

ITS provide valuable and cost-effective tools to the NWP members for improving mobility, safety and efficiency. Because of their value, technology solutions are playing an increasing role for transportation agencies, resulting in more capital and operational expenditures. Additionally, travelers and agencies are more dependent upon the technologies reliably providing their functionality.

The Federal Highway Administration (FHWA) requires state departments of transportation are required to submit an annual Transportation Asset Management Plan (TAMP) to intended to serve as a "Strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their life cycle."[1] A TAMP provides a framework for resource allocation and use, and is intended to result in optimized transportation investment decision making based upon quality data and consistent analysis. The FHWA only requires reporting and analysis on, at a minimum, bridges and pavement.

Agencies can include assets beyond traditional infrastructure in their TAMPS, such as ITS, and some do. Examples of ITS in TAMPs are summarized in this report. However, there is no consensus on how to define ITS assets and how to effectively manage them. While agencies may document what they consider to be ITS assets, guidance for consistent data collection and analysis needed to report their condition, performance, lifecycles and potential risks is lacking.

The purpose of this report is to summarize the current state of ITS asset management, both in the NWP states and across the nation. The objectives of the report are to:

- Document the extent to which states recognize ITS in asset management practices.
- Describe the role of ITS asset management in optimizing transportation investment.
- Identify ITS asset management best practices among the NWP states.
- Identify needs among the NWP states to improve their ITS asset management.

The report is based on interviews, discussions and data provided by the NWP states. In addition, the TAMPs of more than a dozen other states that included ITS at some level were reviewed.

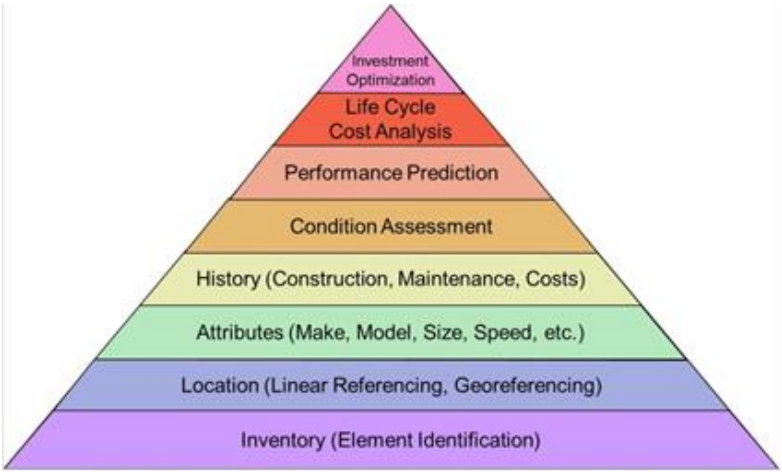
[1] TRB Report 632 (National Cooperative Highway Research Program, 2009)

2. TAMP Requirements

The Moving Ahead for Progress in the 21st Century (MAP-21) Act was enacted in 2012. It established a performance-based highway program with the goal of "Improving how Federal transportation funds are allocated."[2] MAP-21 requires each state to develop a risk-based TAMP that must contain:

- **A summary of bridge and pavement assets on the National Highway System within the state**, such as quantities of bridges or miles of pavement
- **A condition report for bridges and pavement**, often in terms such as those that are in "Good," "Fair" and "Poor" condition
- **A performance gap identification**, which describes the gap between the existing and predicted performance level for each asset type and that required based on current and future factors, such as traffic demand growth
- **Lifecycle costs**, defining capital and maintenance and operation costs for assets and the methodology for determining the costs
- **Risk management analysis**, analyzing the programmatic and system risks associated with the assets
- **A financial plan** that summarizes the funding outlook for managing the assets in the short and long terms
- **Investment strategies** that describe key work strategies that have been derived from the asset management process

Figure 2 shows transportation asset management as a pyramid, with the objective of investment optimization as the capstone built upon several levels of related data and processes. The levels are consistent with the federal TAMP guidance and are applicable to ITS as well as traditional transportation assets. However, the specific data and processes of each level can be very different due to the unique characteristics of ITS. These characteristics are discussed in the next section.



Source: Dave Huft, South Dakota Department of Transportation

Figure 2: Levels of Asset Management

[2] Generic Work Plan for Developing a TAMP (FHWA, 2013)

3. Unique Characteristics of ITS Assets

In reporting ITS asset management, some states have attempted to emulate the process in place for bridges and pavements, which includes tracking the inventory, its value and its condition. While the objective of asset management is to optimize investment, ITS assets have unique characteristics that necessitate a different approach than that used for traditional transportation assets. The unique characteristics include, but are not limited to, the following:

- While it is possible to estimate ITS asset lifespans, the assets typically do not degrade the way infrastructure assets do, such as the gradual degradation of pavement smoothness as a result of wear and environmental conditions. Instead, the condition of many ITS assets is binary; they are either operational or not operational, such as a camera either capturing images or not.
- ITS asset attributes such as condition and location can change frequently. For example, a sign may not be operational one day because of a power failure, but back on line the next. Or, a camera may be moved between work zone sites. This dynamic information may have value for operations in addition to for investment optimization.
- ITS assets are not necessarily fixed in place once deployed. They can be moved. This is especially true of mobile and portable devices such as equipment for work zones or temporary installations but can also include assets that are relocated.
- ITS assets may be centralized and provide functionality to a large area, not a specific location. Examples include systems that provide statewide functionality and cloud-based systems.
- ITS assets can have components and/or software upgraded to change or improve their functionality.
- ITS assets can become obsolete without physically degrading. Examples of this may be when an ITS asset is superseded by newer, more advanced technology, or when a communication standard changes and the asset can no longer securely or adequately send data.
- ITS assets depend upon other systems such as the communications network and other systems with which data is exchanged.
- The failure of ITS assets is not typically catastrophic to the transportation network. While a road or bridge failure can stop some travel, when an ITS asset such as an electronic sign or camera fails, the network can continue to serve travelers at reduced efficiency.

4. Classification of ITS Assets

ITS is defined by the FHWA as "electronics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system[3]."This definition is broad and can include field devices, centralized systems, integrated computational systems, communications and networking equipment, hardware, software and portable equipment.

[3] Intelligent Transportation Systems Architecture and Standards, Definitions, https://ops.fhwa.dot.gov/its_arch_imp/policy_1.htm#940_3, FHWA, 2001

In the literature review and interviews with NWP states, the project team found that states commonly define ITS assets more narrowly than the federal definition. Most, but not all, states that include ITS in their TAMPs limit the inventory to field devices. Even when only including field devices, states vary, with some only including traffic signals, and others including devices such as cameras, detectors and electronic signs.

In 2016 and 2017, FHWA developed a geospatial ITS asset database that is limited to assets in the field[4]. The database was populated from survey responses from states and municipalities. The database has a comprehensive list of the types of ITS field devices. An image of the map display focused on part of Duluth, MN from the database is shown in **Figure 3**. Because the database does not contain complete information on all assets and has not been consistently updated since it was launched, it no longer accurately depicts the ITS inventory in NWP states. Additionally, the database does not include connected vehicle field assets.

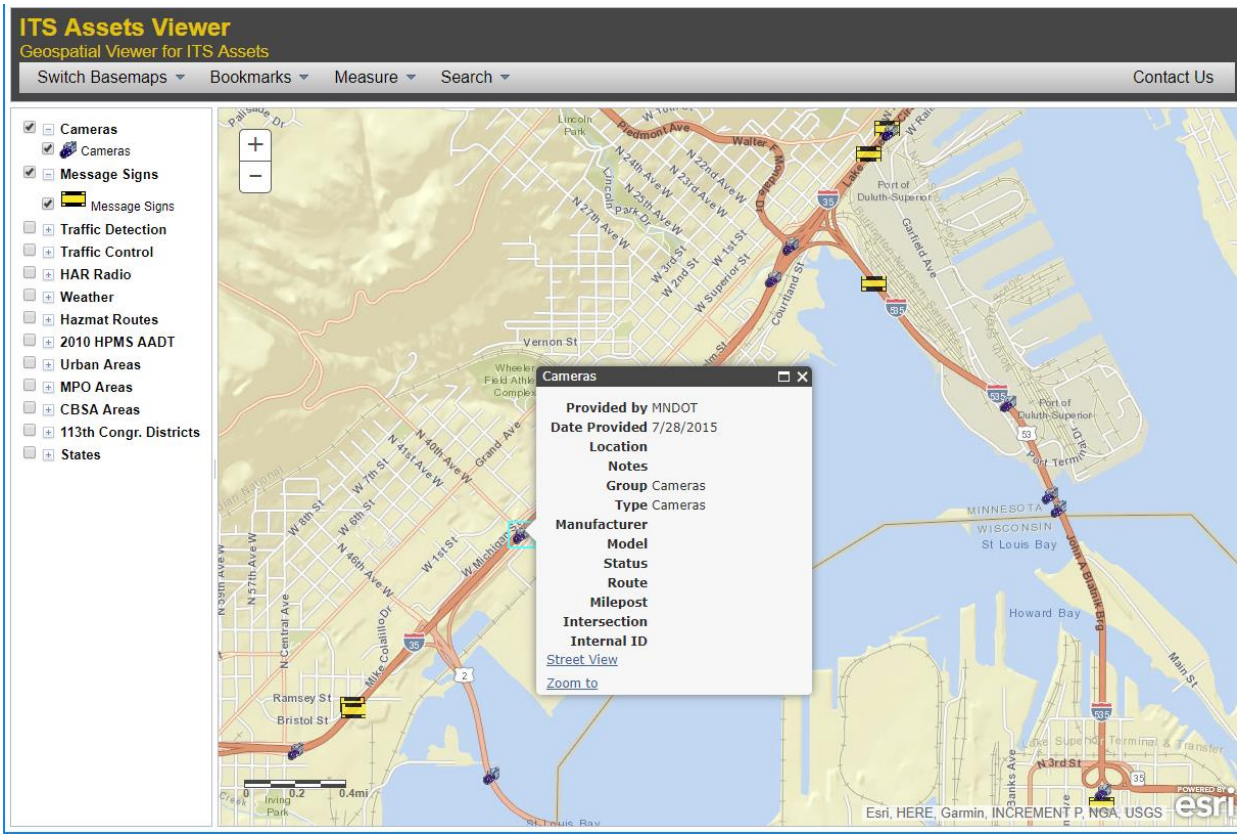


Figure 3: Screen Capture of FHWA ITS Assets Viewer

Whether states consider an asset to be ITS depends on who owns or maintains the asset within the state, regardless to whom it provides functionality. For example, some states have not included Environmental Sensor Systems (ESS) as ITS because they are operated by a maintenance division. Similarly, agencies often do not include software that is key to ITS operations, such as Advanced Traffic Management Systems

[4] FHWA ITS Asset Viewer - https://www.itsassets.its.dot.gov/

(ATMS) and Advanced Traveler Information Systems (ATIS), because they are administered and maintained by the agency's Information Technology (IT) section.

Based on interviews, the contents of the FHWA ITS Asset Viewer tool and a literature review, a summary of assets that may be considered ITS has been developed and classified by type in **Table 1**. The asset classes recognize the different functions and challenges associated with each asset type. The table lists the asset class, provides asset types that further distinguish the assets by function and presents by examples of assets that may fall within each type. The examples are not exhaustive because each state may have unique assets. As previously noted, not all agencies consider all example assets to be ITS.

Table 1: ITS Asset Classes

Asset Class	Asset Types	Asset Examples
Field Devices	Cameras	• Traffic • Video detection • License plate reader
	Connected and Automated Vehicle	• Roadside Units (RSUs) • Antennas
	Emergency Call Boxes	• Call Boxes
	Electronic Clearance	• Toll plazas • Commercial vehicle ports
	Highway Advisory Radio	• Broadcast units
	Message Signs	• Dynamic Message Signs (DMS) • Blank out
	Sensors	• Traffic detectors • Commercial vehicle dimension • Weigh in Motion (WIM) • Roadway intersection conflict warning Systems
	Road Weather Information Systems (RWIS)	• Stations
	Traffic Control	• Controllers • Gates • Lane control • Pre-emption signals • Ramp meters • Reversible lane sign • Signals • Variable Speed Limit • Warning flashers
	Traffic Detection	• Detectors
	Weigh in Motion	• Fixed • Portable
Communications and Networking	Communications	• Fiber • Copper • Radio / Microwave
	Networking	• Networking hardware • Video equipment
	Servers	• On-site server facilities

Asset Class	Asset Types	Asset Examples
Hardware/ Software		• On-site servers • Workstations
	State-owned, licensed, cloud-based software	• Asset Management • Connected Vehicle • Geographic Information Systems (GIS) / Linear Referencing Systems (LRS) • Maintenance Decision Support Systems (MDSS) • Traffic Management • Traveler Information • Video Management
Portable	Mobile	• Probes (e.g. snowplows)
	Portable	• Smart work zone • Arrow boards • Portable DMS, cameras, etc.

An additional potential ITS asset class considered for this study was data, which is becomingly increasingly important in transportation operations. This asset can include purchased or licensed data such as traffic volume, speeds and incidents available from third parties such as HERE, Waze and Google. It may also include agency-collected data that is critical for operations such as traffic management, maintenance decisions and planning. However, no states currently list data as an ITS asset, so it is not included in this report.

5. ITS Assets in TAMPs

The project conducted a literature review of transportation asset management plans that are publicly available, including from NWP states and others to identify how existing TAMPS have reported ITS.

Table 2 summarizes the TAMPS that were reviewed. The table provides:

- Agency developing the plan.
- Whether the plan was submitted to the FHWA.
- ITS asset classes included in the plan.
- The extent to which ITS assets were reported, including condition, asset value, risk analysis and funding considerations.

The reviewed documents listed in Table 2 do not necessarily reflect the maturity of ITS asset management in a state, only in how they have publicly reported their ITS asset management. Other plans may be developed or in development for use by the state.

Table 2: ITS Assets in TAMPs

State – Plan (Year)	FHWA Submittal	ITS Asset Classes Included	Condition	Performance Targets	Lifecycle Costs	Risk Analysis	Funding
Alaska – Asset Management Synthesis for the Parks Highway Corridor (2012)	N	• Field Devices	Y	N	N	N	N
California TAMP (2017)	Y	• Field Devices	Y	N	N	N	N
Colorado Risk Based Asset Management Plan (2013)	N	• Field Devices • Communications	Y	Y	Y	Y	Y
Connecticut TAMP (2018)	Y	• Field Devices	Y	Y	N	N	N
Georgia TAMP (2014)	Y	• Field Devices • Communications and Networking • Hardware	N	N	N	N	N
Minnesota TAMP (2018)	Y	• Field Devices • Communications • Hardware and Software	Y	Y	Y	Y	Y
New Jersey TAMP (2014)	Y	• Field Devices • Software	Y – for signals	Y – for signals	N	N	Y
Pennsylvania TAMP (2014)	Y	• Field Devices	N	N	N	N	N
Rhode Island TAMP (2018)	Y	• Field Devices • Communications and Networking • Hardware and Software	Y	Y	Y	Y	Y
Utah TAMP (2018)	Y	• Field Devices • Communications	Y – reports whether or not devices are opera-tional	Y	Y	Y	Y

Because TAMPS submitted to the FHWA require consistency in reporting on the traditional TAMP assets of bridges and pavements, comparisons or summations across states as to the conditions, values and needs for their management are relatively easy. The consistency allows a reader to understand the relative condition and value of traditional transportation assets. However, as illustrated in Table 2, little consistency exists in the reporting of ITS assets and how they are assessed. Asset condition reporting varies from state to state. Some states identify the condition of ITS assets based solely on age, such as that all traffic signals over 25 years old are in "poor" condition, while all signals newer than ten years are "good." Others use operational status to assess condition; devices are either "operational" or "non-operational."

6. NWP State ITS Asset Management

All NWP states were interviewed regarding their ITS asset management practices. The purpose of the interviews was to determine:

- The status of the states' ITS asset management practices
- Challenges to performing ITS asset management
- Best practices among the states

The interviews provided a more detailed perspective of the ITS asset management efforts of the state than is reported in a TAMP. This section summarizes each of these topics as reported by the NWP states.

6.1 Status of ITS Asset Management in NWP States

Table 3 is a brief summary of the status of ITS asset management within the NWP states, including the levels of the asset management pyramid (Figure 2) that each performs. The table summarizes what each state includes as ITS assets, how each state performs ITS asset management and the tools used.

This table summarizes the levels of ITS asset management performed by each state but assesses the level of integration of each state's activities. As discussed later in this report, some states perform several levels, but the activities are not necessarily in coordination with each other or for asset management.

Table 3: ITS Asset Management in NWP States

State	ITS Asset Management Plan	ITS Asset Types	Asset Management Tools Used	Levels of ITS Asset Management*		State Notes
Idaho	N – ITS asset investment is planned through the Statewide Transportation Improvement Program (STIP)	• Field Devices • Hardware/ Software • Portable	Multiple files, including spreadsheets, to track different asset types, such as RWIS, message signs and cameras.	Inventory	E	• ITS assets are not tracked in a single, centralized location. • Idaho uses Agile Assets for Transportation Asset Management but have not incorporated ITS assets into the system at present. • Portable devices are tracked by the individual districts where they are operated. • Attributes for field devices includes utility information, such as power and communication providers and their contact information.
				Location	E	
				Attributes	E	
				History	E	
				Condition	N	
				Performance Prediction	N	
				Life Cycle Costs	N	
				Investment Optimization	N	
Minnesota	Y – Included in federal TAMP	• Field Devices • Communications and Network	Commercial software Agile Assets is used to manage ITS assets and is tied to the LRS for location data.	Inventory	E	• Portable ITS is tracked through fleet management but not included as part of the inventory in Agile Assets. • Optimization is conducted through establishing a target budget by asset class. • Replacement costs are tracked, but not depreciated value of existing assets.
				Location	E	
				Attributes	E	
				History	E	
				Condition	E	
				Performance Prediction	N	
				Life Cycle Costs	E	
				Investment Optimization	E	

State	ITS Asset Management Plan	ITS Asset Types	Asset Management Tools Used	Levels of ITS Asset Management*		State Notes
Montana	N	• Field Devices • Communications and Network • Portable	ITS assets are documented in the Statewide ITS Architecture and in the Agile Assets Maintenance Management System (MMS)	Inventory	E	• Most levels of asset management are conducted in the MMS. • Lifecycle costs are tracked through work orders within MMS.
				Location	E	
				Attributes	E	
				History	E	
				Condition	E	
				Performance Prediction	N	
				Life Cycle Costs	E	
				Investment Optimization	N	
North Dakota	Y – in the Statewide ITS Strategic Plan (2016)	• Field Devices • Communications and Networking	ITS field devices are tracked in a GIS database.	Inventory	E	• The strategic plan is updated every four years. • Asset age is tracked but health is not, and devices are operated until they fail, then replaced. • Risk assessment is conducted for some devices (i.e. WIM and traffic detectors).
				Location	E	
				Attributes	N	
				History	N	
				Condition	E	
				Performance Prediction	N	
				Life Cycle Costs	N	
				Investment Optimization	N	

State	ITS Asset Management Plan	ITS Asset Types	Asset Management Tools Used	Levels of ITS Asset Management*		State Notes
South Dakota	N – the state currently has multiple spreadsheets containing ITS asset information.	• Field Devices • Communications and Network • Hardware and Software	State-configured version of a Commercial-Off-the-Shelf asset management tool is being developed.	Inventory	E	• The asset management tool under development will bring all data into a single tool and allow for asset management reporting and analysis. • The asset management tool will allow for photos and documents to be stored as part of asset records. • The asset management tool will be capable of doing simple asset depreciation calculations. • Hardware and software assets include cloud-hosted software, such as a truck permitting system. • Investment optimization will be performed outside of the tool but using its data.
				Location	E	
				Attributes	E	
				History	E	
				Condition	E	
				Performance Prediction	P	
				Life Cycle Costs	P	
				Investment Optimization	P	
Washington	N – however, Washington is currently planning to develop a plan in 2020.	• Field Devices • Communications and Network • Hardware and Software • Hardware and Software	State-developed Signal Maintenance Management System (SIMMS) is a database of inventory and maintenance for each asset.	Inventory	E	• SIMMS also serves the functions of work report management (generation, documentation, and photos/file management) and labor/equipment use tracking. • SIMMS is 20 years old and the State has considered modernizing and expanding it to include additional assets. • Each region develops a list of assets that need to be replaced, based on age or obsolescence.
				Location	E	
				Attributes	E	
				History	E	
				Condition	E	
				Performance Prediction	N	
				Life Cycle Costs	E	
				Investment Optimization	N	

State	ITS Asset Management Plan	ITS Asset Types	Asset Management Tools Used	Levels of ITS Asset Management*		State Notes
Wyoming	N – but the state has a centralized, comprehensive database of ITS assets that it uses for operations and planning	• Field Devices • Communications and Network • Portable	State-developed Oracle database	Inventory	E	• The Oracle database has an interface that allows for use and data entry by field staff. • Attributes for field devices includes utility information, such as power and communication providers and their contact information. • Database tracks real-time operational status of ITS assets and is the state's authoritative source of data on ITS asset characteristics. • Performance predictions and lifecycles are not tracked in the database but discussed in scheduled calls with district staff
				Location	E	
				Attributes	E	
				History	E	
				Condition	E	
				Performance Prediction	N	
				Life Cycle Costs	N	
				Investment Optimization	N	

- E = Existing, P = Planned, N = No

6.2 ITS Asset Management Challenges

As shown in Table 3, the NWP states have successfully performed the foundational levels of ITS asset management as identified in the pyramid in Figure 2, such as inventorying and locating their ITS assets. However, most states have not successfully in adequately performing the levels that build upon those, such as performance prediction and lifecycle costs, which are essential in order to optimize ITS investment.

The following common challenges were identified in states as barriers to effective ITS asset management.

Lack of Uniform ITS Assets and Criteria Definition

While it is important to recognize the unique services that ITS provide in each state, and that no two states are alike, the lack of uniform asset definitions underlies the other challenges identified by the NWP states. As discussed earlier, the federal definition of ITS is broad and the states typically define their ITS assets more narrowly. It is expected that each state will have a different inventory of assets depending upon their functional needs. However, a clear definition of the types and classes of ITS could provide states with a framework for inventorying their ITS assets. The criteria for ITS assets are the data used to determine condition, lifecycle, maintenance needs and other information needed for effective asset management. Currently, states establish their own criteria, frequently ad hoc and based on their own experience, such as observation of failure rates of a specific device type.

A uniform framework that includes asset definitions and criteria would support comparing and exchanging information nationally and creating larger data sources of ITS asset information that may be used as resources to understand the condition, performance and maintenance needs of ITS assets. Standardized criteria would support agencies identify the data to collect and strategies for evaluating the data. Standardized criteria would also provide for agencies to more easily share and aggregate information.

Standardization of assets and criteria for traditional transportation assets has allowed an industry to develop with commercial-off-the-shelf software tools and professional support. The lack of commonality in states' unique processes for ITS assets prevent similar economies of scale.

Limited Availability of Information Resources

Traditional transportation asset management has many available information resources, and the FHWA provides guidance through an asset management subsection of its web site.[5] States indicated that there are few information resources beyond those they develop on their own to help them effectively perform ITS asset management. Missing resources include guidance for data collection and asset maintenance and inspection. Guidance to help agencies understand expected lifecycles of assets by using measures such as Mean Time to Failure (MTF), likely failure or trouble issues for specific devices, and sample maintenance documents that can be used to estimate ongoing costs and to include in third-party maintenance contracts are also lacking. Other information the NWP states desired but could not access include when new standards will be adopted so that agencies can plan for obsolescence and replacement.

[5] FHWA Asset Management Home Page - https://www.fhwa.dot.gov/asset/

Limited Staffing Availability and Skills

In most NWP states, ITS asset management is not part of a formal job description or business process. It is frequently performed ad hoc by one or more individuals in headquarters and at the districts. However, when the role is not formally defined it does not include time for staff to adequately collect, and manage, and analyze data, acquire training, and perform necessary inspections.

Lack of Tools

While the survey of NWP states shows that the agencies currently perform many levels of ITS asset management, the reality in some states is that much of that work is done ad hoc, with data spread across multiple systems. For example, a GIS database may contain the inventory and its locations while a different system may track the maintenance history of each ITS asset. Or, data may be collected at the district level and not be part of a statewide asset management business process at the statewide. There is a need for tools and guidance that help agencies collect, analyze and use their asset data to make both operations and investment decisions.

A robust market exists for commercial tools to support traditional transportation asset management including software that integrates and interfaces with other state systems such as GIS or Linear Referencing Systems and maintenance tracking systems. While some vendors have developed custom modules to support the management of ITS assets, these customizations tend to be expensive and specific to the client's needs and not to a broader market. The lack of ITS asset and criteria definitions may prevent software developers from creating tools that can perform ITS asset management.

The states that have most successfully aggregated and analyzed data are those that have developed their own software tools or done significant customization to commercial products. Both options are resource-intensive.

6.3 NWP State Best Practices

Through conducting the interviews and reviewing state documents, a set of best practices that advanced and supported ITS asset management were identified. The following is a summary of those NWP state best practices.

Manage ITS Assets Different Than Other Transportation Assets

Transportation agency culture is evolving to recognize the importance of not only building roads but also operating them and the technologies that support them. However, the review of state TAMPs showed a tendency for agencies to treat ITS assets as they treat pavement and bridges, including assessing their condition and value based on age. This approach potentially limits capturing data relevant to ITS assets.

An alternate approach is to recognize that ITS assets like Information Technology (IT) assets in their characteristics and attributes such as:

- Software / firmware updates
- Component-swappable
- Dependence on communications and power for operation
- Obsolescence from technological advance or lack of technical support
- Security concerns

It may be possible to more accurately assess the performance, maintenance and lifecycles of ITS assets by managing them like IT. IT assets are considered to "rapidly depreciate and require constant update and replacement."[6] They require a strategy that covers their entire lifecycle, including not only replacement but upgrades, continual improvement and awareness of the impact of moving the assets or changing the external resources upon which their operations rely, such as networks and data sources. IT assets also benefit from "well-defined processes that ensure efficient, consistent and accurate execution of IT asset management tasks and activities."[7]

Centralize ITS Asset Information

As previously discussed, some states store ITS asset information across multiple locations, such as location and status in an ATMS and condition and history in maintenance tracking software. This can result in difficulty in aggregating data for analysis and in conflicts when the multiple sources are not all up to date.

Some NWP states have developed strategies for centralizing ITS asset data. In the NWP states, and in research of other states, these solutions tend to be customized specifically for their states. They include South Dakota's custom configuration of a commercial asset management software and Washington and Wyoming's self-developed databases with customized interfaces. These solutions that aggregate asset management data allow for data management and analysis.

In some NWP states, staff has access to asset data at the office and in the field. Staff performing maintenance and inspections on specific assets can directly update information regarding condition and history and keep the data up to date. Field staff can also access to information such as maintenance history or the histories of similar devices to better understand potential problem areas.

A consideration for centralizing ITS asset information is developing interfaces to other systems that contain and use ITS asset information such as ATMS, MDSS and GIS to ensure that all systems are using the same information. Interfaces may also enable staff to access and enter data and provide robust reporting tools and a platform that allows for different levels of access for different types of users. For example, field staff may use tablets that allow for capturing images and location data.

Use ITS Asset Information in Operations

As mentioned above, Wyoming has developed a database to manage ITS assets and support systems operations. The database is an authoritative source of the ITS asset information that can be called upon by other systems and by office and field staff.

Wyoming has included operations-specific information in the database such as the status of devices, such as whether a sign or camera is currently operational. Additionally, utility and contact information is included so if a field device has stopped communicating, office and field staff can identify and contact the appropriate local power and communications providers.

[6] ITS Asset Management: It's All About Process, https://www.gartner.com/imagesrv/media-products/pdf/provance/provance_issue1.pdf, July, 2011
[7] ibid

Be Flexible in Data Collection

Because ITS assets do not have uniform definitions of condition, agencies have developed unique ways to capture this information. South Dakota's new ITS asset management system will enable users to include attachments and photos of the assets. This allows the agency to capture photographic evidence of the condition of not only the asset, but any structures and housing associated with the asset. For example, photos can show the condition of mast arms or housings or can demonstrate the wiring of a device to field staff. Attachments can include maintenance documentation, troubleshooting guides, as-built diagrams, or warranty information useful to office and field staff.

Use Staff Knowledge to Identify Issues

All NWP states identified their own staff experience as a reliable source for assessing the health of their ITS assets. In particular, the states said they had great success in involving field staff in identifying health issues, such as the performance of specific devices or components. For example, the field staff may be the first to identify that a particular type of battery performs poorly under certain environmental conditions, or that a wireless communications medium does not meet the requirements in a certain area due to poor coverage.

Agencies benefited from formalizing the process of gathering the knowledge and experience of staff. Their processes included using asset tracking and management tools to document staff notes and comments and holding regularly-scheduled meetings to discuss ITS asset health and conditions. Staff members can compare notes and share ideas to help identify common ITS asset health issues and to share successful maintenance strategies and determine cost-effective approaches to keeping ITS operational.

7. ITS Asset Management Recommendations

The following recommendations address a potential set of common needs among NWP states for ITS asset management information and resources.

7.1 A Common ITS Asset Framework

As discussed previously, FHWA requires specific information to be reported on the condition, performance, lifecycle and investments for asset management of pavement and bridge assets. They also provide many resources to guide agencies through the process. As a result, there is a robust and mature industry surrounding traditional transportation asset management that include commercial software tools in a wide range of costs, as well as professional services for agencies. Perhaps because there are no federal requirements or guidance, very limited tools and are resources available for ITS asset management.

The practice of ITS asset management would benefit from federal guidance that has the input and support of state agencies. The guidance would not need to include any requirements, but it should provide a framework, possibly similar to the guidance and template documents currently available for TAMPs, that helps clarify the federal definition of ITS assets, the criteria that should be used to measure asset condition, lifecycle and value, and a process for improving investment in their deployment and operations.

The framework could provide common ground for states as they advance their practices and make it easier to share their research and lessons learned. In addition, it would provide definitions that software developers and professional service providers could apply, resulting in economies of scale.

7.2 Funding for Operations

The NWP states identified better operations funding opportunities as a need to keep their ITS assets operational and providing the required functionality. There was a perception that in addition to deployment and replacement of ITS, states need funding that recognizes the need to perform maintenance and to upgrade assets as necessary to keep them functional.

Appropriate levels of funding to operate ITS are a key component of optimizing investment. Proper maintenance and timely upgrades can result in lower overall ITS investment because existing systems can be kept in service longer. In addition, dedicated operations funding allows agencies to plan for the life of the assets rather than just for their deployment.

7.3 Asset Management in Transportation Systems Management and Operations (TSMO)

TSMO identifies strategies and technologies that optimize the efficiency, safety, and utility of the existing transportation network. It is a way to identify and implement processes within agencies that will improve the use of existing resources, including ITS, or enhance the existing resources and processes and produce greater returns on investment than would be expected from traditional transportation solutions.

FHWA has supported states adopting a TSMO approach to solving transportation challenges. FHWA provides guidance for developing TSMO program plans that includes training and documentation.[8] Several states, including some in the NWP, have developed TSMO plans that address institutional issues such as staffing, agency organization structure and shifting agency culture away from solving problems with traditional solutions such as road widening, and tactical strategies to use ITS to improve issues such as incident response, freeway management and multimodal coordination.

Incorporating ITS asset management into TSMO may be a logical extension given the use of ITS in TSMO strategies. By ensuring that ITS assets are well-managed, an agency can implement TSMO strategies with greater confidence that the ITS assets are available and capable of providing the functions required.

TSMO plans also often contain funding plans to implement the strategies. Because these plans focus on operations, they can be an appropriate place to identify the costs to maintain and operate ITS.

[8]Organizing and Planning for Operations - https://ops.fhwa.dot.gov/plan4ops/focus_areas/integrating/transportation_sys.htm