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RECOMMENDED PRACTICE

American Public Transportation Association
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Transit Asset Management Working Group

Improving Asset Management Through Better Asset Information

Abstract: This recommended practice provides guidance for transit agencies to enhance how they specify, provision and manage asset information, thereby improving their approach to asset management.

Keywords: transit asset management, asset information, transit asset management plan, asset information strategy, decision-making, data, information management, EAM systems, information standards, information governance, information quality, information requirements

Summary: This document provides guidance for transit agencies wishing to enhance their asset management. It uses as its basis the four asset information subjects defined in the IAM's "Anatomy of Asset Management" and provides good-practice and practical tips within each subject. The development of Transit Asset Management Plans (TAMPs) will yield a good understanding of the information needed for that document, the realities of what the agency has available, and the corresponding opportunities for improvement.

Scope and purpose: The guidance in this document is applicable to asset-intensive organizations wishing to improve their asset information, from the largest Tier 1 rail property to the smallest transit agency with only a handful of vehicles. These guidelines are intended to support the creation of appropriate and good-quality asset information, which is critical to support optimized decision-making and good-practice asset management within asset-intensive organizations.

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Introduction

This introduction is not part of APTA SUDS-TAM-RP-005-19, "Improving Asset Management Through Better Asset Information."

APTA recommends the use of this document by:

- individuals or organizations that operate transit systems;
- individuals or organizations that contract with others for the operation of transit systems; and
- individuals or organizations that influence how transit systems are operated (including but not limited to consultants, designers and contractors).

# Improving Asset Management Through Better Asset Information

1. Introduction to asset information

Transit agencies across the United States are required by the Federal Transit Administration (FTA) to develop and cyclically refresh a Transit Asset Management Plan (TAMP), which consolidates information on their asset inventory and its age, condition and performance; describes how investment decisions are made; and identifies capital projects for improving the "state of good repair" of their assets. See **Figure 1**.

In doing so, many transit organizations have found their asset information to be in poor shape: Information is incomplete, untrustworthy, out of date, inaccessible or missing altogether. As a result, making informed, confident decisions about their assets across their life cycle proves challenging. Often, senior executives are unaware of the low-quality data on which their asset management decisions are made.

Appropriate and good-quality asset information is critical to support optimized decision-making and good-practice asset management within asset-intensive organizations. This recommended practice provides guidance for transit agencies wishing to enhance how they specify, provision and manage asset information, thereby improving their approach to asset management.

FIGURE 1
Factors in Creating a TAMP
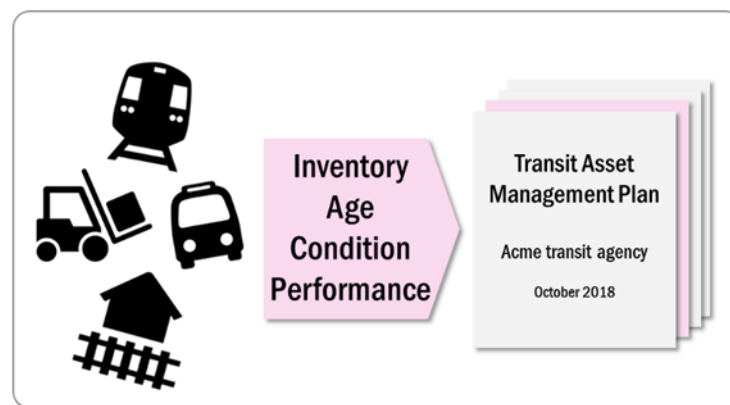
The Institute of Asset Management (IAM) defines asset information as a "combination of data about physical assets used to inform decisions about how they are managed, both for short-term operational purposes and for long-term strategic planning." Given this definition, transit agencies typically have the following types of asset information:

1. Information about the assets themselves, including types, volumes, locations, age, condition and spares

2. Information about the work planned and performed on the assets, including capital replacement and refurbishment, and preventive and reactive maintenance
3. Information about asset operations, including historical failure rates such as mean time between failures, asset utilization levels, asset performance (targets and actuals), and operating schedules and outages (planned and current)
4. Information about the asset supply chain, including spare parts, purchase orders, suppliers and contracts
5. Information about asset finances, including historical capital and operating costs, capital and operating budgets, costs centers and capital asset registers
6. Information about the engineering of the assets, including as-built drawings, as-maintained configurations, cut sheets, maintenance manuals and test results.

An agency's asset information will be either structured or unstructured. For the most part, structured data refers to information with a high degree of organization, such that it can reside in relational databases and is readily searchable—whereas unstructured data is essentially the opposite, and not easily searchable, including formats like audio, video, photos, scans and printed materials. While technology to search unstructured data is emerging (like optical character recognition and face-recognition software) its lack of an orderly internal structure means search is far slower than for structured data. On top of this, transit agencies typically have far more unstructured than structured asset information, including O&M manuals, training materials, engineering specifications, as-built drawings and other historical paper records.

> **TIP:** Not all information in a transit agency is asset information. For example, HR records for employee home addresses and Social Security numbers do not comprise asset information. See **Figure 2**.

**FIGURE 2**
Scope of Asset Information

The IAM definition above stresses that asset information informs long-term and short-term decisions about the assets through their life cycle. Good decisions are based on knowledge, which relies on information, which in turn is underpinned by data. This concept is illustrated in **Figure 3**, using a short-term operational decision about traction power.

FIGURE 3
Operational Decision Example
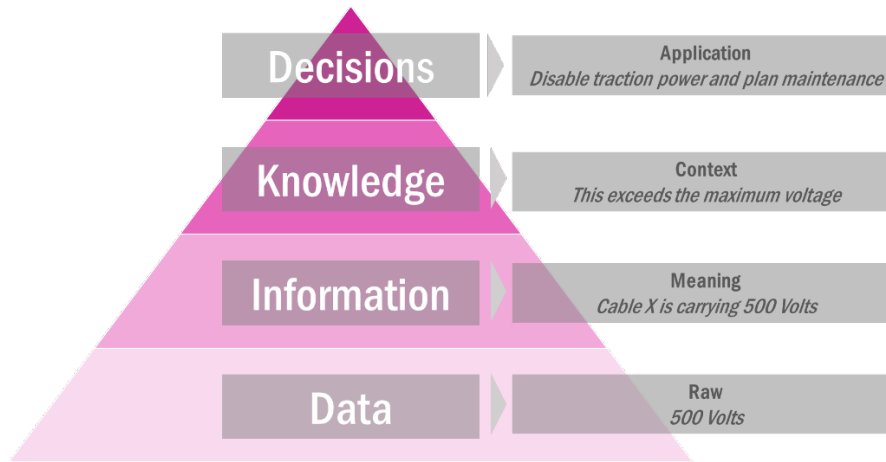
Examples of long-term strategic decisions about transit assets could include the following:

- How frequently should an asset class be replaced?
- Should the agency continue to maintain an asset or schedule a replacement?
- What risks are posed by assets to the organization and how should the agency best mitigate those?
- Should the agency expand its transportation network into a new location (particularly where that would involve installing new physical assets)?

This recommended practice uses as its basis the Asset Management Anatomy from the Institute of Asset Management. The anatomy introduces the "Conceptual Model for Asset Management," which describes the six areas of asset management, and beneath the six areas the "39 subjects" of asset management. Asset information is one of the six key areas, and there are four asset information subjects beneath that. The conceptual model is reproduced in **Figure 4**, along with the four subjects related to asset information.

FIGURE 4
Conceptual Model for Asset Management
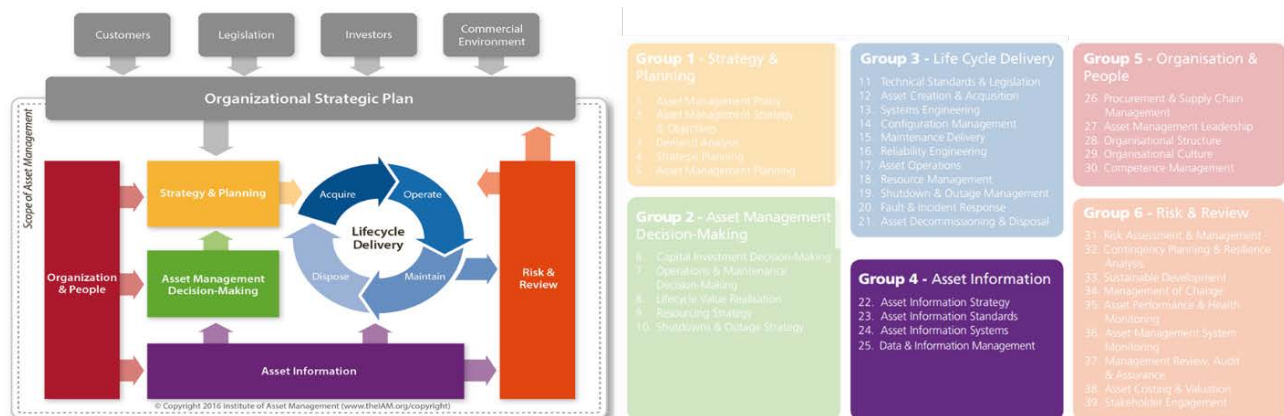
The four asset information subjects from the IAM anatomy are:

Asset Information Strategy
Defining the agency's strategic approach to the definition, collection, management, reporting and overall governance of its asset information.

Asset Information Standards
The specification of a consistent process, structure and format for collecting, storing and updating asset information, and for reporting on its quality and accuracy.

Asset Information Systems
The information systems the agency has in place to support its asset management activities.

Data and Information Management
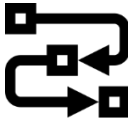The data and information held within the agency's asset information systems and the processes for its management and governance.

The remainder of this paper is organized under the four subjects above.

2. Developing an asset information strategy

When seeking to improve their approach to asset management, organizations often start with information systems, typically either by procuring a new system or by seeking to enhance existing systems. This approach can introduce risks and inefficiencies because, due to their automated inaccuracies, the systems will not meet the needs of the organization without agency-specific configuration of their workflows, permissions and the information they store. Instead, it is recommended that transit organizations prioritize the development of an *asset information strategy* before making any significant investment in, or changes to, their asset information systems.

An asset information strategy is a foundational document to improving asset information across the organization. Its recommended content includes:

1. **Asset information policy:** Principles and goals for asset information at the agency.
2. **Asset information scope:** What constitutes asset information at the agency.
3. **Stakeholders, needs, challenges and priorities:** The asset management stakeholders, the information they need, the information challenges they face and the priorities for resolution.
4. **Current state:** The existing standards, systems and management processes in place today.
5. **Desired state:** The standards, systems and management processes required to address the prioritized needs and challenges.
6. **Strategy and roadmap:** The strategy for moving the agency from its current state to the desired state, along with an implementation roadmap.

The following provides hints and tips for the recommended content.

2.1 Asset information policy

A set of principles or goals that encapsulate how the agency wishes to manage its asset information.

> **TIP:** Agencies should talk to their asset management stakeholders to understand their information challenges and to develop principles that would help overcome those. For example, a common challenge is that information exists in multiple repositories with no clarity on what constitutes the "true" data. A principle to address such a challenge could be that the organization will strive to reach a single, trusted source for its asset information.

2.2 Asset information scope

Not all organizational information is asset information, and the strategy should clearly define what the agency considers to be asset information, as well as the scope of the information to which the strategy applies.

> **TIP:** A good starting point is the information already in the TAMP and reported to NTD, including inventory, age, condition and performance information. Agencies should use the IAM definition of asset information to further refine their own scope.

2.3 Information stakeholders, needs, challenges and priorities

Agencies should identify the people who make either short-term operational or long-term strategic decisions about agency assets. Asset decision-makers who rely on asset information will exist both inside and outside the organization, and typically include:

- operations and maintenance staff who touch the assets on a regular basis;
- capital planners responsible for planning the capital expansion or replacement of the agency's assets;
- finance staff responsible for managing capital and operating budgets;
- engineers responsible for managing initial asset design and ongoing changes;
- long-range planners responsible for projecting long-term asset demand, utilization and growth;
- senior executives who make strategic decisions about the assets; and
- elected officials who represent asset users (customers) and sometimes can make budgetary decisions related to an agency's assets.

Once an agency has identified the stakeholders, determining their informational needs, challenges and priorities is a key step to understanding what changes need to occur to the current state at the agency, and with what priority. Asset information commonly needed for decisions on transit assets includes the items shown in **Table 1**.

TABLE 1
Asset Information Commonly Needed for Decisions

Basic Information Commonly Needed	Advanced Information Commonly Needed
• Asset types, volumes and locations* • In-service date, manufacture year and/or year rebuilt* • Age vs. useful life benchmark* • Current condition and annual mileage (for vehicles)* • Original capital cost, and whether the agency is responsible for replacing the asset* • FTA grant information, such as the grant number and the percentage of federal funds* • Performance restrictions (particularly for linear assets)* • Available spares and parts • Basic engineering information, such as the as-built and as-maintained configuration	• Asset defects, failures, root cause analysis and related coding • Change in condition and performance over time • Unit costs for capital replacements and maintenance tasks • Likelihood and consequence of asset failure • Maintenance history, including hours, costs, and materials • Historical capital investments, particularly when cross-referenced against changes in condition or performance • Asset systems/interconnections (useful when considering replacements and how they might impact other assets)

* FTA reporting requirements

Common information challenges in transit agencies can include:

- information spread across multiple, unintegrated systems, with lots of data silos and no "single source of truth";
- poor quality or missing information, with information hard to locate and trust;
- large volumes of unstructured data, particularly in paper form;
- insufficient resources to adequately collect and maintain information;
- resistance to information collection and sharing across the organization;
- unclear responsibilities for information management;
- missing or inconsistently applied standards for recording information;
- challenges in matching local conventions to federal reporting standards;
- poor information handover from asset suppliers;
- knowledge drain as people retire and take information with them; and
- collecting more information than is necessary or useful.

When interviewing stakeholders, agencies should focus on what long-term and short-term asset-related decisions the stakeholders are responsible for making, the information they need to support those decisions and challenges they face in doing so.

> **TIP:** This can also be a good opportunity to share with them the data already compiled for the TAMP and the FTA National Transit Database and ask them how they can use it in their work.

2.4 Description of the current state

Agencies should research and describe their current conditions for asset information, including the currently employed information standards, systems and management approach. They also should consider describing the status of the existing asset information within the organization, including its type, quality, where it is stored, who collects it and at what frequency.

> **TIP:** This section should be kept relatively short. An agency may have existing asset information standards that are not labeled explicitly as such; they can look for procedures or guidance material for asset information systems that describe what information should be captured and how.

2.5 Description of the desired state

An agency should describe its desired state for asset information, typically in terms of the information itself, associated standards, IT systems, technology and management approach. (The following sections contain further details on each.)

> **TIP:** When developing the desired state, agencies should consider the needs, challenges and priorities of their stakeholders, judged against what is already in place.

2.6 Strategy and plan

Agencies should describe the strategy for getting from the current state to the desired state, consider some strategic options and select the preferred option(s). They should then develop an implementation roadmap for the preferred option(s), by describing the specific actions the agency will perform, by when and what resources are needed to implement the preferred strategy.

> **TIP:** Many transit agencies have found that it's best to start relatively small, focusing on a particular asset class, information type, business process or operating location, and then gradually scaling up the strategy as lessons are learned. Some agencies have chosen a strategy to yield the biggest benefit first, by prioritizing improvement of asset information for high-value and high-criticality assets.

3. Asset information standards

Once an organization clearly understands its information needs through the development of its asset information strategy, it should then consider what standards are necessary to overcome some of the challenges and address the needs. A good asset information standard should describe:

1. **Scope and context:** The type of information the standard covers, and why it exists.
2. **Needs:** The information needs of the stakeholders to which this standard is responding.
3. **Classification and hierarchy:** How the information is structured, organized and classified.
4. **Attributes:** The specific sub-types of information to be collected against each record.
5. **Quality requirements:** Any information rules for ensuring the quality of the information.
6. **Information processes:** Information life-cycle processes for information creation, update and disposal, as well as management processes for review, approval, quality auditing, retention and change control.
7. **Governance and improvement:** How this standard is approved, maintained and continually improved.

Standards should be identified and developed based on the needs, challenges and priorities of agency stakeholders. Standards can cover a wide range of information types, but transit agencies may find greatest value in developing standards for the asset register and its associated attributes, including conventions for asset naming, condition and criticality; maintenance work (preventive and corrective), including universal work codes; asset failure codes; and technical documents, including document naming, version control and filing standards.

> **TIP:** There are several existing industry standards that could form the basis for agency standards, including COBie, Uniformat II, OmniClass and buildingSMART standards. These are all standards for facility-type assets; however, OmniClass now includes some standards for linear assets. The oil and gas industry developed ISO 14224:2016, which, while originally designed for oil and gas assets, may provide a useful starting point.

4. Asset information systems

Once an agency's asset information needs and challenges are clearly understood from its strategy, it can consider the extent to which they are addressed by agency asset information systems.

There is significant emphasis within many transit agencies on establishing a system to hold the asset register and manage maintenance work orders, traditionally referred to as a computerized maintenance management (CMMS) system and more recently referred to as an enterprise asset management (EAM) system. However, it is important to note that asset information extends beyond simply the information about the assets and the maintenance work performed on them. Therefore, asset information systems extend beyond a CMMS or EAM system.

Figure 5 provides a conceptual overview of the different systems that may collect, store or enable access to asset information within a transit organization.

FIGURE 5
Asset Information Systems
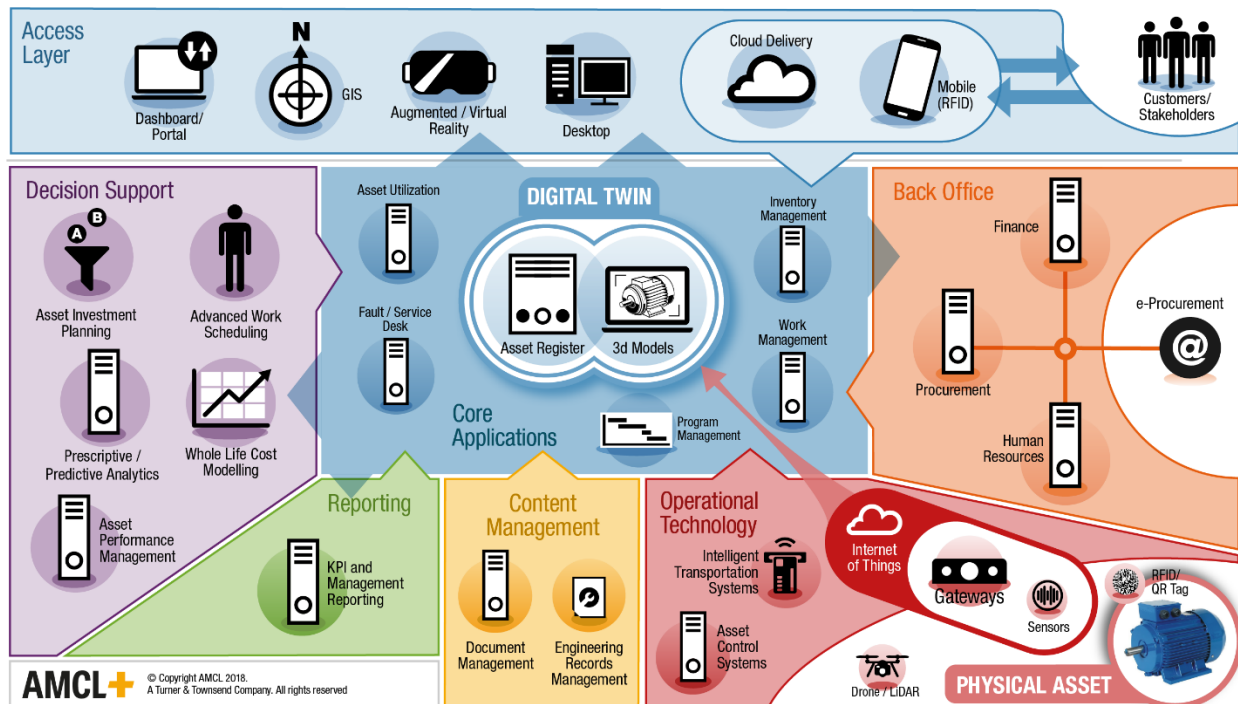
New asset information technologies beginning to take hold include the use of drones for asset inspections, RFID tags for asset identification, and equipping assets with sensors to enable real-time assessment of asset performance and environmental conditions through the internet of things. Combining these increasing data feeds with artificial intelligence techniques, such as machine learning, are driving a revolution in prescriptive decision support, with categories of asset information systems such as asset investment planning and asset performance management becoming more popular. However, transit agencies should proceed with caution and consider their own asset management and asset information maturity and readiness to adopt and gain value from these new technologies.

Advancements in the building information modeling space (BIM—increasingly referred to as "better information management"), and its adoption in infrastructure, are increasing the availability of 3-D models and digital representations of assets. BIM's structured approach supports the specification and collection of asset information throughout the asset life cycle, from initial design and handover through to operations and maintenance and eventual disposal. The combination of this information with the asset register, whole-life models of behavior, and real-time readings from the asset itself, enables the concept of the "digital twin," in which a digital representation of the asset is created and updated in real time.

Transit agencies often have multiple asset information systems with poor or limited integration, including spreadsheet or paper-based information repositories. Even relatively modest enhancements to existing systems can yield benefits. For example, adding required fields to systems, drop-down menus with limited selections and Excel-based data load templates can enforce an agency's asset information standards at the point of entry and avoid the "Wild West" of free text across an organization.

For transit agencies procuring and embedding enterprise-wide asset information systems, the effort should be treated as a significant organizational change, as it will often fundamentally change not only existing business processes, but also any culture of information silos or hoarding that can occur with offline repositories.

> **TIP:** The implementation of asset information systems is fraught with risk; a high percentage of IT systems and technology programs fail to meet stated benefits. As well as ensuring effective organizational change, it is essential that asset information needs from the asset information strategy be used to develop structured business and functional requirements. Agencies must ensure that the asset information system's implementation has considered strategic and tactical decision needs, such as asset performance, as well as operation decisions like maintenance planning.

Seek opportunities to streamline processes where possible, rather than simply recreating potentially inefficient processes in the system, introducing change incrementally to assist users with the transition. Avoid traditional waterfall procurement methods, which, while standard for infrastructure procurements, are usually not flexible enough for software projects, in which agency requirements will often not be fully understood at the time of procurement. Instead, agencies should adopt an agile approach to procurement that allows for iteration and feedback between agency and supplier and supports the understanding of the agency's requirements to evolve as the system is designed, configured, tested and used.

Agencies should avoid the temptation to customize functionality to the extent possible, as this adds complexity, cost and risk—but they should be prepared to spend the necessary time and effort understanding their information and business processes before configuring the system.

> **TIP:** Additional data entry will be a burden on operations; agencies should design data entry from the end user perspective (typically but not always maintainers) for fast and efficient data capture.

For additional guidance on the procurement of asset information systems, refer to APTA SUDS-TAM-RP-004-18, "Selecting Software to Support your Asset Management Program."

5. Data and information management

The approach to the management of data and information is arguably the most important. Without good management measures in place, a strategy will not be sustainable, standards will not be consistently applied, and asset information systems will continue to collect poor-quality data, leading to sub-optimal short-term and long-term decision-making about assets. Data and information management is broad, but can include the items in this section.

5.1 Establish clear roles and responsibilities for information

Agencies should consider assigning formal accountability for the asset information to a position or committee. They should identify who is best placed to enter information in the asset information systems, and who should perform initial quality checks. (Should field maintenance staff enter, with quality checks performed by a supervisor, or should quality checks be performed by a centralized function?) Agencies should define clear roles and responsibilities for the information across its life cycle (creation, update, disposal) and the management processes applied (quality audit, retention, change control, etc.). Agencies should remember to consider both structured and unstructured information.

> **TIP:** Agencies may wish to use a RACI matrix to define who is responsible, accountable, consulted and informed for each information lifecycle and management process.

5.2 Design and implement an information quality audit

Agencies should define and implement a quality audit program that reviews asset information against defined standards and has the authority and means to define, implement and enforce corrective actions. Quality measures should be used to determine information quality and should be captured in agency standards as quality requirements. Agencies may consider fostering "competition" among asset owner groups to achieve

information quality, internally publishing audit results or using gamification to encourage engagement and adherence to standards.

Common quality measures include those listed in **Table 2**.

TABLE 2
Components of a Quality Audit Program

Quality measure	Description	Tips
Completeness	The extent to which a dataset is populated	• Completeness can be measured • It may be valid for a data set not to be 100 percent complete
Validity	Whether different data attributes are valid, e.g., asset install date decades before the technology used was invented	• Ongoing cross system checks will test validity • Validity issues will be discovered during system usage
Consistency	Whether the same entity can be positively linked between two systems	• Either use same identifiers in two systems or provide cross-reference capability
Timeliness	Timeliness of data updates and provision of data to users and interfacing systems	• Assess process timeliness • Improve system performance
Accuracy	Whether stored data correctly reflects the asset it represents	• Checking data against the real entity it represents

5.3 Train staff about how to enter, use and maintain information

Agencies can support the users of their asset information systems with appropriate training for those systems. They should identify bad information habits and the means through which they are passed on, and work to address them, either through training, coaching or enforcement.

> **TIP:** Agencies should include key asset management concepts in their asset information training courses to provide a broader context for how asset information supports long-term and short-term decisions about the assets.

5.4 Optimize business processes to make data entry quick and easy

Agencies should document existing processes for capturing and updating asset information, such as asset handover to operations and final decommissioning, and identify opportunities to streamline and standardize where possible. Agencies should include clear requirements for asset information collection and handover in supplier contracts, building these requirements into all standard procurement and contract documents. Business processes such as configuration management and document management have close ties to asset information.

> **TIP:** The asset handover process is a key entry point for information about any new assets, and yet the information provided by suppliers is often poor or missing altogether. Developing—and enforcing— clear information handover requirements (including information format, classification and structure) is an important element of an agency's specifications. Consider including an Asset Information Handover Plan as a supplier deliverable, to get greater assurances on what and how information will be handed over.

5.5 Improve legacy data on a prioritized basis

All transit organizations have large volumes of legacy data in their information systems. Putting in place measures to develop standards, enhance systems and enact management processes will help ensure information quality in the future, but it will not improve the information already captured.

Improving legacy information can be a complex and time-consuming undertaking, and agencies may consider taking a multifaceted approach based on the priority of the information and the associated cost of improvement. Options include:

1. Field-based inspections to update individual information records, e.g., performing condition inspections or more accurately determining the make and model of an asset. This is most appropriate for the highest priority information, as it is the costliest to implement.
2. Office-based individual updates of asset information system records by asset experts, e.g., making targeted updates to specific asset records based on expert maintenance knowledge of the assets, such as installation date.
3. Office-based batch updates of asset information based on business rules, e.g., assigning the same condition rating to all assets of a similar age, or applying the same installation date to all assets in a room.
4. Archive in read-only form to avoid any further reliance on it, but still allowing access as needed. This is most appropriate for the lowest priority information.

Often a combination of the above four approaches will be employed.

6. Conclusion

Appropriate and good-quality asset information is critical to support optimized decision-making and good-practice asset management within asset-intensive organizations.

The Institute of Asset Management (IAM) defines asset information as a "combination of data about physical assets used to inform decisions about how they are managed, both for short-term operational purposes and for long-term strategic planning."

This recommended practice provides guidance for transit agencies wishing to enhance how they specify, provision and manage Asset Information, thereby improving their approach to Asset Management. It uses as its basis the four asset information subjects defined in the IAM's "Anatomy of Asset Management" and provides good-practice and practical tips within each subject:

1. **Asset information strategy:** Defining the agency's strategic approach to the definition, collection, management, reporting and overall governance of its asset information.
2. **Asset information standards:** The specification of a consistent process, structure and format for collecting, storing and updating asset information, and for reporting on its quality and accuracy.
3. **Asset information systems:** The information systems the agency has in place to support its asset management activities.
4. **Data and information management:** The data and information held within the agency's asset information systems and the processes for its management and governance.

Related APTA standards

References

Institute of Asset Management, "Anatomy of Asset Management." theiam.org/knowledge/Knowledge-Base/the-anatomy/

Definitions

None.

Abbreviations and acronyms

CMMS   computerized maintenance management system
BIM   building information modeling/better information management
EAM   enterprise asset management
FTA   Federal Transit Administration
IAM   Institute of Asset Management
IT   information technology
NATSA   North American Transportation Services Association
NTD   National Transit Database
O&M   operations and maintenance
RACI   responsible, accountable, consulted and informed
RFID   radio-frequency identification
TAMP   Transit Asset Management Plan

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