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Capital Asset Inventory and Condition Assessment

Abstract: This document outlines the initial steps needed to create and/or improve asset management within a transit agency, regardless of transit agency size. It outlines how to manage capital assets from procurement to disposal (i.e., over the life cycle).

Keywords: asset inventory, condition assessment, transit asset management, state of good repair, performance management, MAP-21

Summary: A managed capital asset life cycle can provide critical data for analyzing costs of operating a transit service that, in turn, highlights the benefits and considerable cost savings to be had in standardizing assets. The asset management program forms the basis for long-term financial planning (a projection of future expenditures) that reconciles both the objectives of operations and maintenance and capital budgeting, thus collectively contributing to extension of the useful (economic) life of assets. Investment in capital assets must be systematic and data driven. Collecting regular condition and performance data to better focus scarce resources on coaxing greater reliability from aging assets is central to being good stewards of public funds. Asset management contributes to shaping not only organizational strategies; it becomes a critical input in shaping regional and urban planning, understanding what sustainability goals can be met, and planning for the future health of the transit system. This document is organized into the following sections:

- Defining and organizing capital assets
- Developing an asset inventory
- Assessing the condition of assets

Scope and purpose: The scope of this *Recommended Practice* is to address the level of detail necessary to maintain in an inventory of assets, the essential data elements of inventory, the process in collecting this data and, most importantly, how this information can influence decision making. The condition and risk assessment of assets guides organizations in prioritizing its day-to-day work activity as well as its long-term strategic plan/capital rehabilitation and replacement program.

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The American Public Transportation Association greatly appreciates the contributions of the **State of Good Repair Working Group**, which provided the primary effort in the drafting of this *Recommended Practice*.

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Capital Asset Inventory and Condition Assessment

1. Defining and organizing your assets

This document focuses on assets as defined by the Asset Management guide commissioned by the Federal Transit Administration (FTA). It is important to distinguish between the asset definition for financial and asset management control purposes. An example of requirements for tracking assets for financial control may be a cost threshold in addition to an estimated useful life of greater than one year. The definition for asset management control needs to focus on questions such as:

- Is the asset repairable or replaceable?
- Does it require maintenance?
- Is it inspected?
- Does it require individual tracking for reliability or performance purposes?

Creation of an asset inventory may begin, for example, with review of the financial inventory and procurement records. These are lists of assets that have been deemed necessary to meet the desired levels of service and that need to be maintained, and are a requirement for input into a maintenance work order system. This inventory may serve as the baseline inventory that could be evaluated for inclusion into a comprehensive asset inventory.

Transit capital assets vary significantly based on service mode, performance requirements and maintenance requirements. A well-structured asset portfolio hierarchy facilitates the asset management process and provides effective support for maintenance activities. It further provides the basis for aggregation of costs data. Every management system requires a grouping of assets for performance measurement, cost analysis or reporting purposes.

There are several hierarchical relationships both proposed and currently in use. These hierarchies include those developed by FTA - Transit Economic Requirements Model (TERM and TERM-Lite) - the FTA Asset Management Guide, FTA Standard Cost Categories (SCC) for Capital Projects, and the requirements for the National Transit Database (NTD). There is a recommended list of elements should be included in the top tier of a capital asset hierarchy (see Appendix A for an example industry standard). When developing an asset hierarchy, be mindful of internal and external business practices and reporting requirements.

Below is an example of a top-tier hierarchy:

1. **Guideway elements** refers to the structural elements that allow for the movement of an agency's fixed-guideway vehicles. Guideway assets are broadly categorized into track elements, above-grade structures (bridges), below-grade structures (tunnels), and ancillary structures (e.g., passenger and maintenance access and retaining walls).
2. **Facilities** refers to the structures that enclose or support maintenance, operations and administrative activities. Facilities also house specialized equipment that supports the operations and maintenance of the vehicles (e.g., fueling and washing facilities). Other examples include the grounds, roofs, mechanical and electrical equipment, plumbing, and all fixed equipment at a bus or rail maintenance or administrative facility.

3. **Systems** include a diverse set of monitoring and control systems that support core operational functions. All of these systems are critical to the transit system, providing power, (including all building substations, third rail, catenaries, etc.) communications, revenue collection, security and safety controls (e.g., radio, GPS, video surveillance, farebox and wireless).
4. **Stations** provide shelter for customers. Examples include bus/rail station structures, elevators/escalators and passenger waiting areas.
5. **Vehicles** refers to rolling stock that is used to provide revenue or nonrevenue service. Rolling stock can include heavy rail, light rail, streetcars, buses, paratransit vehicles, ferryboats, service vehicles, yard tugs and street supervisor vehicles.

Once the organization has defined its high-level asset hierarchy, it must then determine the depth of the asset breakdown for each category. The development of an asset breakdown structure (ABS) is based on the top-tier hierarchy and can go many levels down. Each high-level category may have multiple methods of categorization. **Table 1** includes an example of a breakdown per top-tier hierarchy.

TABLE 1
Sample Asset Breakdown Structure

Top tier	Fleet	Facilities	Rail Guideway	Systems	Stations
Second tier	revenue coaches	Property (rail repair facility)	line	signaling	Hawthorne Station
Third tier	All coaches within a production group	building (service building)	tracks	audible	escalator
Fourth tier	individual coach	roofs	rail	relay	escalator motor
Fifth tier, etc.	Vehicle components (e.g., engine Cummins ISB)	adhesive system	Linear (station 02 to 03)		

Again, it is recommended that each organization determine the level of depth it wishes to collect and monitor in an asset management system. Ultimately, the decision should determine which users/customers the data serves. The AM process may need only aggregated cost, condition and risk data obtained through a rollup.

2. Developing an asset inventory

Once the depth level of assets to collect within each tier is determined, the agency must collect, store and maintain current an **inventory of capital assets**. This information is usually stored in an asset management system database. The intent of these systems is to serve as a source of data for life cycle management.

Each asset should have, at a minimum, its unique **asset identifying** information stored within the asset management system.

The asset information required for an asset management system can be broken down into the following four groups:

1. Asset attributes
    - unique name, number, description, asset class/group
    - asset nameplate (make, model, serial)
    - location

- quantity of each item
- purchasing information (vendor, contract, date, price, warranty, etc.)
- date placed in service
- expected useful life (projected, remaining or planned)
- expected replacement value (by value, Consumer Price Index, etc.)
- rehabilitation schedule and associated costs

2. Asset criticality (impact to organization as a result of failure)
3. Asset condition (snapshot of its current state to its expected state)
4. Asset history Work order tracking, including ongoing maintenance and rehabilitation. .

All assets deteriorate with age, the anticipated useful life of the asset is a most important piece of information that one can obtain about any asset.

However, there is risk in focusing too much on assets' "age." Specifically, by relying heavily on age assessment, properties may **overstate** the need for funding and dis-incentivize devising and implementing modern maintenance methodologies and practices. These modern practices provide the opportunity to extend useful life and result in considerable savings through delaying the need for recapitalization.

The failure of such an asset can impact the organization's ability to meet service and would be defined as a **critical asset**. Assets need to be viewed in terms of criticality in the delivery of service. When assessing criticality, the organization should ask the following three questions:

- How can the asset fail?
- What is the likelihood of failure?
- If the asset fails, what is the impact?

The organization should seek to develop a methodology in order to maintain standardization when assessing the **condition of an asset** or series of assets..

Example

For example, 40-year-old tracks are able to function and meet performance needs despite the fact that their condition is deteriorating and they are approaching the threshold for replacement. They are still safe, but each grinding session, each hot weather season, each time a train rolls over them, the tracks get closer and closer to their threshold for replacement.

2.1 Populating the asset inventory

A physical inventory of the capital assets should be collected and validated on a periodic basis. The physical inventory verifies the existence of the asset and provides an assessment of its condition relative to its useful life. This can be compared with the recorded inventory to verify plans, use and maintenance. The agency needs to decide a long term methodology to maintain the integrity of the asset inventory data.

2.1.1 Tools

A range of tools are available to the industry, from something as simple as a spreadsheet or a small database to something as sophisticated and complex as an Enterprise Asset Management System.

Each agency should use its normal business practices and tools (i.e. handhelds) to leverage data acquisitions and maintenance activities. It would be prudent for agencies to look at emerging technologies to more efficiently acquire data, lowering labor costs.

2.1.2 Developing a baseline inventory

The initial recommended step when developing an asset inventory is to determine what asset inventory data are available for each asset class. The places to start gathering asset inventory data would be:

Examples:

- Existing asset inventory register
- Maintenance management system (MMS)
- Contracts
- CAD drawings/As-builts
- Insurance policies
- Financial records
- O&M budget requests
- Corporate tenured knowledge

This inventory may serve as the baseline inventory that will be evaluated for inclusion into an asset inventory for asset management purposes.

2.1.3 Adding assets

Newly acquired assets need to be added into the asset management system regardless of acquisition method. Many agencies are now including a requirement within their proposals for their vendors to provide an asset inventory with all asset attributes along with the parts and maintenance manuals. The agency has the responsibility to complete the asset record including data such as criticality and condition codes. .

2.1.4 Modifying assets

Any activity that significantly changes the asset record – attributes, criticality, and/or condition of an asset – needs to be updated to keep the inventory current. See Section 2: Developing an asset inventory for a list of asset attributes.

2.1.5 Retiring assets

Any retirement or disposal of an asset needs to be reflected in the inventory and should be appropriately reflected in any future agency-wide condition assessment.

2.2 Condition assessment approach

Condition assessment is the process of inspecting, analyzing or testing assets to collect data that is used to measure condition and performance. The condition assessment process involves regular inspections, testing or analysis.

There are varying degrees of consensus and industry standards of practice for inspecting and monitoring condition. In many cases, only a sampling of the asset class needs to be inspected. The size of this sample and frequency of inspection should be directly related to the level of risk associated with this asset. The condition measure provides indicators of the likelihood that the asset will perform as intended. There are some condition inspection and assessment requirements that are mandatory, which means that they are required by law or as requirements from federal or other funding agencies.

The process should be based on several factors including asset breakdown structure, existing business practices, technology, etc.. There is no one-size-fits-all answer for condition assessment. Although an asset inventory and an asset condition assessment may be performed separately, considerable cost savings are possible if they are performed concurrently. A task added to a specific preventative maintenance activity may offer the opportunity to capture the information required for an asset inventory and condition assessment. The development of an asset inventory, a condition assessment and a tagging strategy serve as a foundation for the development of a capital improvement plan.

With scarce resources, agencies are faced with constrained capital budgets. Many agencies have found that developing a decision tool assists in the prioritization of capital expenditures. The decision support tool can assist an agency in bringing their system into a state of good repair. Appendix A is an example of steps used by Chicago RTA in collecting its inventory.

The methods an agency may use can be a snapshot of the entire inventory or a statistical sampling. Some agencies will do the entire assessment once every five years. Others will spread out their assessment over five years doing one-fifth each year throughout the year. And others will sample the entire population in the five years, but the critical assets may be assessed more frequently. This last method allows the agency to continuously review those critical assets more often, which can lead to improved performance.

Once the agency has determined it is ready to do an inventory, it is best to organize the inventory by the first tier or second tier of assets. An inventory of an agency’s fleet will definitely be different from an inventory of its facilities. Below are multiple examples of ways to perform an inventory of assets.

Appendix A: Inventory assessment methodology

(Developed by Chicago Regional Transportation Authority [RTA])

The following recommended steps are herewith offered in order to follow a relatively easy, seamless, affordable and understandable procedure in developing an asset inventory and asset condition assessment.

1. Based on the agreed upon condition assessment strategy and agency may assemble an inventory assessment team composed of in-house asset stewards and contracted asset type experts to form a project team to collect and assemble the data into the inventory/assessment (I/A). The in house staff may be asked to work part time on the I/A or to take it on as a temporary full time project.
2. Review sample inventory / assessments within this report, and select one or more to use as a guide for your I/A. Guidance and templates for this process will be forthcoming.
3. Define, tally, categorize and construct a living listing of every asset type, to form the basis of your agencies I/A. This is meant to be a large exhaustive list of every asset type within the agencies properties. For example a large transit system may include as many as 100 asset types broken into as many as 10 categories. These may include facilities, structures, rolling stock, track, yards etc. When assembling an inventory for the first time, asset data will most likely need to be obtained from a variety of sources. Potential asset data sources include:
    - Prior I/A efforts
    - Maintenance Management Systems (MMS, e.g., Maximo, Ellipse etc…)
    - Fleet roster (for vehicles)
    - Department level / asset manager records: which may exist in spreadsheet format
    - Fixed Asset Ledger (accounting system): Generally not a preferred source for larger assets but useful for small value items such as radios, shelters, and non-revenue vehicles
    - Primary data collection:
4. Create a recording template for each asset type (using the guide documents noted above). The templates should be designed to provide enough data to document each asset's type, date built or acquired (to assess age), quantity, unit cost and condition.
5. Determine estimated useful life for each asset. These may be copied from the provided guide document samples or determined by the I/A team.
6. Establish age for each asset. Should the actual purchase or installation date be unavailable, proxies (estimates) must be used to determine these quantities.
7. The ratio of age to useful life can be used to group assets into age quintiles and these quintiles can then be used as simple measures of asset condition as follows:
    - 5 = 25% of useful life consumed
    - 4 = 26% to 50% of useful life consumed
    - 3 = 51% to 75% of useful life consumed
    - 2= 76% to 100% of useful life consumed
    - 1 = > 100% of useful life consumed
8. Populate the asset type templates with available data. Proxies (educated estimates) must be used for any unavailable data in order for the I/A to be as complete as possible.
9. Perform an inspection of a sampling segment of each asset type in order to verify the consistency of the calculated conditions above with the observed conditions. This activity may necessitate changes to some of the condition ratings of the I/A.
10. Determine replacement costs (Cost to replace with new asset) for each asset. Knowledge of the original cost is helpful in this task. If unavailable; a proxy must be used to estimate such. This quantity represents the System Replacement Value. How do we handle betterment of an asset? Technology etc.

11. Calculate the replacement cost for all assets that exceed their useful life (i.e., rated 1 using the condition measure suggested above). This quantity represents the Backlog.
12. Determine the time period for the asset condition assessment. For consistency it is recommended that a 10 year period be utilized by all agencies. Create a 10 year matrix using Excel or other to record the following..
13. Determine any anticipated asset replacements (example bus fleet replacements) and any anticipated large capital investments (example locomotive half life overhaul) over the 10 year period. This quantity represents the Normal Reinvestment. Plot these on the 10 year matrix.
14. Add the quantities Backlog and Normal Reinvestment. This quantity represents the. SOGR Need for the ten year period.
15. In order to visualize the size of the SOGR Need, it is helpful to compare it to the System Replacement Value. This can be done by simply dividing the SOGR need for the ten year period by 10 to get an Annual average SOGR need. This quantity can be compared to the agency's System Replacement Value. For example, one large older agency's SOGR need for the ten year period is $26.4B. This amounts to an annual average SOGR need of $2.6B. Its System Replacement Value is $140B. By dividing the $2.6B by $140B we can see that the annual average SOGR need for this agency amounts to 1.8% of its System Replacement Value.

In order for different agencies' quantities to be comparable, a level of consistency is important. As mentioned in item 12, it is recommended that all agencies utilize a consistent 10 year I/A period. In that same spirit, it is also recommended that the quantities used throughout the assessment period remain in starting dollar quantities, without addition of yearly inflationary adjustments. These costing upgrades may be added separately to individual reports. It is further recommended that a consistent 20% to 30% be added to all quantities to account for soft costs, including force account and contingencies. It is recommended that after performing a Capital Asset Inventory and Condition Assessment, that it be upgraded every year for five years in order to maximize its accuracy. A following computerized, continual, living, work authorization SOGR tracking system by in house maintenance specialists for the purpose of keeping the State of Good Repair accurately definable over time, by in house forces is an excellent goal.

Definitions

asset dynamics: Data that help predict the costs to maintain or improve an asset's condition over its life cycle.

asset management control: xxxx

capital assets: Fixed, long-term items that will require preservation to add value and utility to an organization.

Abbreviations and acronyms

ABS	asset breakdown structure
CMMS	computerized maintenance management software
DBOM	design-build-operate-maintain
ERP	enterprise resource planning
FTA	Federal Transit Administration
GPS	Global Positioning System
I/A	inventory/assessment
NTD	National Transit Database
MMS	maintenance management systems
PdM	predictive maintenance
PM	preventive maintenance
RFP	request for proposals
RTA	Regional Transportation Authority
SGR	State of Good Repair
TERM	Transit Economic Requirements Model

References

FTA Asset Management Guide
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IIMM
FTA Standard Cost Categories (SCC) for Capital Projects
TERM / TERM-Lite

