## Chapter 7

# Measure Calculation

**Once one has established all of the parameters for the asset value calculation, the task remains to calculate value for individual assets or groups of assets. One should compare the asset value calculated to that used for financial reporting. In addition to calculating overall value, one may calculate other supporting measures, such as the cost to maintain value, asset sustainability ratio, asset consumption ratio, and others.**

### Section 7.1

**Calculating Value for Groups of Assets** describes how the asset value calculation may be applied to groups of assets. It includes a discussion on the potential errors and challenges of aggregation and the treatment of uncertainty. The section also provides steps for completing the calculation.

### Section 7.2

**Preparing Financial Statements** addresses the application of asset value in financial statements and explains how to resolve discrepancies between the approaches used in financial reporting and TAM.

### Section 7.3

**Asset Value-Related Measures** introduces a set of additional supporting measures that are related to asset value.

### Section 7.4

**Practice Assessment** provides examples of emerging, strengthening, and advanced practices for the calculation of current value, the preparation of balance sheets, and the determination of other asset value-related measures.

Chapter 7. Measure Calculation

Section 7.1

# Calculating Value for Groups of Assets

The discussion of how to calculate asset value has thus far focused on how to perform the calculation for a single asset or asset component. This section addresses the question of how to perform the calculation for groups of assets. The following subsections provide an overview of the calculation process and key issues, and recommended calculation steps.

## Overview

The steps detailed in Chapter 3 to 6 detail all of the building blocks of the asset value calculation. The only remaining step to calculate the value of a given asset or component at time t is to subtract depreciation from the initial asset value :

$$V(t) = V(t_0) - D(t)$$

In practice, however, the calculation does not stop there. For most applications one seeks to calculate the value for multiple assets and asset classes, requiring some form of aggregation. Also, one should ideally account for the fact that there is inherent uncertainty in the calculations of asset value, particularly if they are prospective (predictions of future value) rather than retrospective. Additional analysis may be required to address these and other issues.

Note that depreciation should never exceed the initial value of the asset or component. This and other calculation issues may arise depending on the level of detail at which calculations are performed, determination of how different treatments are incorporated in the calculations, and approach used for componentization (discussed in Chapter 3).

### Asset Aggregation

Aggregating asset value calculations can be accomplished in two basic ways: either the asset value calculation is performed for individual assets or components and then the results are aggregated, or assets are grouped together for analysis first and the calculation of value is performed at an aggregate level.

Performing calculations on aggregated data is preferable, as doing so saves effort. However, it is important not to introduce errors in the calculation process by over-aggregating. When data are aggregated one relies on averaging to obtain an aggregate result. Provided the groups of assets are homogenous in their characteristics and all of the underlying relationships being modeled are linear, then one can aggregate prior to calculating value. However, if there is a lack of homogeneity or non-linear effects then aggregating can introduce errors. Examples of situations where aggregation may not be appropriate include:

- Initial costs are calculated using a more complex method than a simple unit cost;
- Initial costs are calculated using a simple unit cost, but this unit costs varies for different assets in the group;
- Useful lives vary for different assets in the group;
- Depreciation is non-linear;
- An asset consists of multiple components with different ages and useful lives, but is being valued at the asset level rather than component level; and/or
- One or more assets or components are fully depreciated.

**Table 7-1** illustrates the issue. Here value is calculated using age-based depreciation for assets A and B. The calculation is performed separately for both, and then at an aggregate level combining the two assets. The table shows the initial value of each asset, and the accumulated depreciation. It also shows the current value, which is the initial value less depreciation. When the calculation is performed separately for each asset the total current value is calculated as $8.2 million. However, when A and B are treated as a single asset, the value calculated is $4.2 million – substantially less!

The culprit responsible for the error in this case is the treatment of depreciation. Asset B is older than the useful life of 50 years, and thus fully depreciated. Once an asset is fully depreciated its value is assumed to be equal to its residual value and not allowed to become negative. This effect is correctly accounted for when the calculations are performed by asset, but ignored in the aggregate calculation in which the average age is used.

**Table 7-1.** Approaches for Calculating Depreciation

| Measure | A | B | Total if Calculated by Asset | Total if Assets are Aggregated |
|---|---|---|---|---|
| Initial Value ($ million) | 11.0 | 22.0 | 33.0 | 33.0 |
| Residual Value ($ million) | 1.0 | 2.0 | 3.0 | 3.0 |
| Age (years) | 24 | 60 | N/A | 48 |
| Useful Life (years) | 50 | 50 | N/A | 50 |
| Depreciation ($ million) | 4.8 | 20.0 | 24.8 | 28.8 |
| Current Value ($ million) | 6.2 | 2.0 | 8.2 | 4.2 |

Ultimately, establishing the correct level of aggregation requires careful consideration of the approach and experienced judgement to determine the appropriate level of detail based on the approach and the asset characteristics.

## Treatment of Uncertainty

The quantitative approaches described in this guide are deterministic – they assume that calculation parameters are known with certainty. In reality key parameters are subject to uncertainty and error, particularly when an analysis is performed at an aggregate level. For example:

- Treatment costs and effects can be highly variable and depending on a large number of factors.
- Future asset deterioration is uncertain, and subject to changes as a result of changing technology, the changing climate, and myriad other factors.
- Future traffic/level of use will drive the benefits obtained from an asset and also depend on economic and demographic factors well outside of the control of an asset manager.
- Economic parameters such as inflation, the discount rate, and the value of time are subject to uncertainty and may be computed differently depending on one's assumptions.

In certain respects, calculating asset value at an aggregate level can help address some of the inherent uncertainties underlying the calculations given parameters such as treatment costs and treatment effects are often derived at this level. Asset level calculations may be more precise – but no more accurate – if they rely on highly variable parameters derived through observations of large populations of assets.

A number of approaches have been developed for handling uncertainty in numeric calculations. Uncertainty is inevitable in calculations of asset value; the question for the analyst is whether the level of uncertainty is tolerable given the manner in which the results of the calculation will be used. The approach recommended here is to acknowledge where uncertainty exists, and – if sufficient time and resources are available – perform sensitivity analyses to show the degree to which changes in key parameters would impact the results of the analysis. For calculations of current value, the analysis may, at a minimum, include testing the impact of changes in asset useful life. For predictions of future value an accompanying sensitivity analysis should also address changes in treatment costs and any economic parameters used in the calculation approach (e.g., the discount rate, if applicable).

# Calculation Steps

The following steps are recommended for calculating current asset value for one or more asset classes and components. These build on the results of prior steps for establishing the scope of the analysis, selecting the initial value calculation approach, identifying treatments, and selecting the depreciation approach.

# Calculating Value for Groups of Assets

**Step 1.**

### Review the Level of Detail in the Calculations

Review the decisions made on the level of detail in the asset value calculation made in Step 1. Combine assets to perform a more aggregated analysis if feasible without significantly impacting the results. Disaggregate the analysis further if key parameters such as costs and useful lives are found to vary within subgroups of assets.

**Step 2.**

### Calculate Initial Value

Apply the approach selected previously to calculate initial value for each asset group, asset or component. Note that in cases where treatments besides initial purchase/construction are included in the analysis and depreciation is based in part or entirely on age, the initial value should be calculated as of the time of the most recent treatment. (but may not be the same as that of a "like new" asset unless the most recent treatment was replacement or reconstruction).

**Step 3.**

### Calculate Depreciation

Apply the selected approach to calculate depreciation for each asset group, asset or component.

**Step 4.**

### Calculate Asset Value

Calculate value as the difference between initial value and accumulated depreciation. Sum the results across components, assets and/or asset classes to obtain total asset value.

**Step 5.**

### Conduct Sensitivity Analysis

Document the impact of changes to key parameters on the calculations of asset value.

## Section 7.2

# Preparing Financial Statements

Asset value is an important component in an organization's financial reports. Much of the prior guidance for calculating asset value has focused on this application. While this guide concentrates on the calculation of asset value to support TAM rather than financial reporting, an asset manager should remain mindful of how an agency develops its financial reports, how asset value is calculated in these reports, and any differences between TAM and financial reporting approaches. The following subsections summarize U.S. public agency financial reporting requirements, and discuss discrepancies between approaches used for asset valuation in financial reporting and TAM.

## Financial Reporting Requirements

Financial reporting requirements for U.S. public agencies are detailed in GASB Statement 34 (***1***). This document requires public agencies to prepare basic financial statements. These should include:

- Assets, distinguishing between capital and other assets
- Liabilities, distinguishing between long-term liabilities and other liabilities
- Net assets, distinguishing among amounts invested in capital assets, net of related debt; restricted amounts; and unrestricted amounts
- Revenues by major source
- Expenses
- Excess or deficiency before contributions
- Contributions
- Special and extraordinary items
- Transfers
- Change in net assets
- Ending net assets

Capital assets are included in the calculation of net assets, but are often presented in a separate table in the financial report. These are defined to include "land, improvements to land, easements, buildings, building improvements, vehicles, machinery, equipment, works of art and historical treasures, infrastructure, and all other tangible or intangible assets that are used in operations and that have initial useful lives extending beyond a single reporting period." Infrastructure assets are further defined as "long-

**Table 7-2.** Example Statement of Capital Asset Activity – Oregon DOT

| | Beginning Balance | Increases | Decreases | Ending Balance |
|---|---|---|---|---|
| Buildings | $282,559,529 | $5,825,276 | $(1,011,511) | $ 287,373,294 |
| Construction in progress - infrastructure | 523,786,457 | 350,031,308 | (253,454,458) | 620,363,307 |
| Construction in progress - other | 26,461,827 | 17,021,568 | (18,255,339) | 25,228,056 |
| Data processing software | 106,812,614 | 24,478,495 | (1,059,400) | 130,231,709 |
| Land | 1,710,428,334 | 12,918,983 | (1,570,400) | 1,721,776,917 |
| Land improvements | 192.994.657 | 2,577,734 | (286,774) | 195,285,617 |
| Land use rights (amortized) | 781,932 | - | - | 781,932 |
| Leasehold improvements | 3,999,333 | 13,500 | - | 4,012,833 |
| Machinery and equipment | 444,479,092 | 18,807,518 | (25,186,989) | 438,099,621 |
| State highway and bridge system | 14,465,090,764 | 379,248,721 | (69,746,542) | 14,774,592,943 |
| Works of art and historical treasures | 101,151 | - | - | 101,151 |
| **Total capital assets** | **$17,757,495,690** | **$810,923,103** | **$(370,571,413)** | **$18,197,847,380** |

Source: Oregon DOT ***(39)***

lived capital assets that normally are stationary in nature and normally can be preserved for a significantly greater number of years than most capital assets." GASB 34 cites as examples of infrastructure assets roads, bridges, tunnels, drainage systems, water and sewer systems, dams and lighting systems.

GASB 34 requires that capital assets are valued using historic costs. Capital assets should be depreciated, but if an agency elects to use the "modified approach" described in Chapter 2 for its infrastructure assets, it is not required that these are depreciated. Instead, the cost to maintain these assets at a specified level of service is established and expensed within the year the cost is incurred.

**Tables 7-2 and 7-3** provide examples showing how capital assets are presented in public agency financial reports. **Table 7-2** is an excerpt from the Oregon DOT financial statement ***(39)***. It shows the beginning balance, increase, decrease and ending balance for each type of capital asset. The value of the state highway and bridge system is reported as a single item in the table with a beginning balance of approximately $14.5 billion and an ending balance of approximately $14.8 billion. In this case, the agency depreciates the value of the system, showing a decrease of $69.7 million from annual depreciation.

**Table 7-3.** Example Statement of Capital Asset Activity – Michigan DOT

| | Beginning Balance | Additions | Deletions | Ending Balance |
|---|---|---|---|---|
| **Capital assets, not depreciated it:** | | | | |
| Roads | $12,860.9 | $123.1 | $(922.4) | $ 12,061.6 |
| Land | 3,146.5 | 7.8 | - | 3,154.3 |
| Bridges | 2,693.9 | 266.1 | (34.4) | 2,925.6 |
| Construction in progress | 1,744.4 | 1,002.5 | (472.3) | 2,274.7 |
| Computer software projects in progress | 6.8 | 2.4 | (6.8) | 2.4 |
| Land rights | 0.4 | 0.2 | - | 0.6 |
| **Capital assets, depreciated:** | | | | |
| Equipment | 241.2 | 9.6 | (3.4) | 247.4 |
| Buildings | 168.9 | 5.4 | (0.1) | 174.1 |
| Blue water Bridge infrastructure | 32.1 | 3.5 | - | 35.6 |
| Railroads | 173.7 | - | - | 173.7 |
| Rest areas & welcome centers | 120.9 | - | - | 120.9 |
| Land improvements | 54.5 | 2.0 | (0.6) | 55.9 |
| Airports | 1.8 | - | - | 1.8 |
| Computer software project | - | 6.8 | - | 6.8 |
| **Less accumulated depreciation for:** | | | | |
| Equipment | (106.9) | (11.5) | 2.7 | (115.6) |
| Buildings | (88.0) | (7.1) | 0.1 | (95.1) |
| Blue water bridge infrastructure | (14.2) | (1.4) | - | (15.6) |
| Railroad | (54.6) | (4.1) | - | (58.7) |
| Rest area and welcome center | (51.9) | (2.7) | - | (54.6) |
| Land improvements | (14.1) | (2.7) | 0.3 | (16.4) |
| Airports | (1.0) | (0.1) | - | (1.1) |
| Computer software project | - | (1.1) | - | (1.1) |
| **Total capital assets** | **$20,915.3** | **$1,398.7** | **$(1,436.7)** | **$20,877.2** |

Source: Michigan DOT ***(40)***

**Table 7-3** is an excerpt from Michigan DOT showing how this agency reports changes in capital assets ***(40)***. Here roads and bridges are reported separately. They are included in the category of "Capital assets, not depreciated" as Michigan DOT uses the GASB 34 modified approach.

The Oregon and Michigan examples are typical of other public agency financial reports. These examples are prepared in a manner that complies with GASB requirements. Asset value is consistently reported for transportation assets using historic costs. Annual depreciation is presented where the agency does not use the modified approach, and agency expenses on infrastructure assets are reported in lieu of depreciation where the modified approach is used. However, the presentation is relatively compact and omits many details that may be of value for asset management purposes, such as details on value by system (e.g., Interstates, NHS) or asset subclass.

## Resolving Discrepancies in Approaches

As discussed in Chapter 2, the use of historic costs, while consistent with best practices in accounting, limits the use of the financial report values for other purposes. However, the GASB 34 modified approach yields an estimate of the cost to maintain the transportation system which is valuable for supporting TAM. Thus, in the event an agency uses the GASB 34 modified approach for financial reporting, an option for supporting TAM is to utilize a consistent approach for reporting asset value in TAM documents, emphasizing the use of the cost to maintain rather than attempting to derive a separate calculation of depreciation. The NHS portion of the overall cost to maintain, calculated using the modified approach, is equivalent to the cost to maintain current value required for NHS TAMPs prepared by State DOTs.

Where the GASB 34 modified approach is not used, it may be preferable to calculate asset value based on replacement cost or market value rather than historic cost. In this case the asset value calculated for TAM inevitably differs from that reported in an agency's financial report. The following approach is recommended to resolve the discrepancy between asset value reported in financial report and TAM documents:

- When calculating asset value for TAM applications, asset managers should carefully review the calculation of asset value in the agency's financial report and obtain further detail on the value by system or asset subclass where possible. It is important to establish "line of sight" between the inventory data used for TAM and that used for financial reporting data (see sidebar).
- To the extent feasible, different calculations of asset value should use common assumptions regarding key parameters, such as replacement costs and asset lives.
- Where it is not feasible to use common assumptions, the differences between approaches should be well documented. Over time it may be feasible to resolve the differences in approaches either by revising the asset valuation approach or presenting additional information in the agency's documents to clarify the different calculations of asset value.

### Establishing Line of Sight Between Asset Registers

**Often there are discrepancies between the asset register used for financial reporting and the asset hierarchy and inventory data used for TAM. Ideally an agency should resolve these discrepancies, so there is a clear "line of sight".**

## Section 7.3

# Asset Value-Related Measures

**This section discusses how to calculate a set of performance measures related to asset value: the cost to maintain current value, asset consumption ratio, asset sustainability ratio, asset renewal funding ratio, and net present value.** For each a definition of the measure is provided, along with guidance for calculating the measure and a discussion of the measure's strengths and limitations.

Note the definitions presented in this guide are similar to those presented in other related guidance, most notably the Institute of Public Works Engineering Australasia (IPWEA) Australian Infrastructure Financial Management Manual (AIFMM) ***(9)***. However, these have been adapted and revised for U.S. agency use and to reflect the range of different valuation approaches presented here.

## Cost to Maintain Current Value

The cost to maintain current asset value helps answer an important question any asset owner is inclined to ask: "how much money do we need to spend?" FHWA requires that State DOTs quantify this value for their NHS roads and bridges in their NHS TAMP. The definition of this measure is shown in the call-out box.

One can approximate the cost to maintain current value by determining annual depreciation for a system. If an agency spent this amount on its system in a given year, then all things being equal, the new spending would offset the annual depreciation, with the result that current value maintained.

### Cost to Maintain Current Value

**Average annual asset preservation, rehabilitation and replacement funding which, if spent over a specified period, is predicted to result in an ending asset value equal to the value at the start of the period.**

However, while this approach to calculating the measure is quite tidy, it suffers from being potentially inaccurate. For complex assets the treatment requirements and costs required for an asset – and to maintain service while the asset is being treated – may bear little resemblance to the cost of constructing a new asset used in the asset value calculation. Also, in many cases the asset value calculation excludes the cost of treatments that impact asset condition. Further, when one bases the estimate on annual depreciation, this provides little basis for further detailing how the cost, if spent, would actually need to be distributed between different assets or treatments.

To address these issues, an agency should ideally calculate the cost to maintain asset value by utilizing its asset management systems. With this approach, asset managers define different potential investment scenarios and identify the least expensive scenario that will maintain or improve average asset conditions and asset value. The reported cost should include all of the costs modeled in the agency's management system used to determine the cost to maintain, which may include other treatments not modeled in the agency's calculation of asset value.

One challenge in using this measure is that the cost to maintain assets' current conditions may be very different from that which an agency needs to spend to maintain its assets in their desired state of good repair. For very new assets, it is inevitable that the asset inventory will initially decline in condition somewhat. For a deteriorated system, it may be necessary to maintain and improve conditions and value.

## Asset Sustainability Ratio

The Asset Sustainability Ratio (ASR) is the ratio of annual asset expenditures to the cost to maintain current value. If the ratio is 1, then annual expenditures are sufficient for maintaining value. If the ratio is less than 1 the system is likely to lose value, and if it is greater than 1 the system is likely to gain value.

The measure has been in use in Australian financial reporting since the early 2000's as described by the Local Government Association of South Australia (LGASA) ***(41)***. Also, it is included as one of the key measures in the AIFMM ***(9)***.

ASR is a valuable measure for summarizing trends in asset spending. Like the cost to maintain current value, it helps identify areas where more spending is needed. Also, given it is a somewhat standardized measure, one can use it to compare asset maintenance methods and asset condition across different systems, assets and agencies.

### Asset Sustainability Ratio

**The ratio of annual asset expenditures, omitting improvements, to the cost to maintain current value. All types of expenditures included in the cost to maintain current value should be included in the calculation of asset expenditures.**

In using ASR it is important to be clear about which costs are included in the calculation of current expenditures and the cost to maintain current value. The Australian definition relies on data available in a financial report: it is the renewal cost divided by annual depreciation. Here it is recommended that all expenditures included in the cost to maintain current value be included in the calculation, though some applications narrow the definition to include only asset renewals, or widen it to include all asset-related work. Further, here it is recommended that the cost to maintain current value be used in the denominator. This may or may not be equal to annual depreciation, depending on the approach used.

The basic challenge in interpreting ASR is the same as that described for the cost to maintain current value. That is, while it is generally desirable to maintain value, there may be cases where some loss of value is acceptable (implying ASR should be less than 1) or where value needs to be increased (implying ASR should be greater than 1). For example a new asset would be expected to lose value initially even if well maintained. Conversely, if a system is in a poor state of repair, then simply maintaining current conditions may not be desirable.

## Asset Consumption Ratio

The Asset Consumption Ratio (ACR) quantifies the portion of the asset that remains after accounting for depreciation. That is, it indicates what percentage of an asset remains to be consumed. This measure ranges from 0 for an asset that is fully depreciated (completely consumed) to 1 (100%) for a new asset. Like ASR, ACR has been used in Australian financial reporting since the early 2000's ***(41)***.

Note this measure is meaningful only in cases where current replacement cost is used as the basis for measuring value, and where some form of depreciation is calculated.

### Asset Consumption Ratio

**The ratio of current asset value to the initial value of an asset when purchased or constructed.**

ACR is valuable as a means for summarizing the relative condition of the asset inventory. It can be a valuable measure for helping summarize trends over time and/or for comparing different asset classes that are otherwise measured using different quantities and scales. However, some asset managers may find it superfluous if they already have well-established approaches for quantifying asset condition.

A challenge in interpreting ACR is in determining what is meant if the ACR is 0 for an asset. Does this mean the asset has failed or still operating but in need of replacement given it has reached its economic useful life and/or is now obsolete? Presentations of ACR should be supplemented with supporting details concerning the assumed useful lives and how these were derived.

## Asset Funding Ratio

The Asset Funding Ratio (AFR) is measure of whether an agency's planned investments are sufficient for achieving and maintaining the agency's desired state of good repair over a 10-year period. If this measure is 1 then planned expenditures are equal to the expenditures needed to achieve and maintain the desired state of good repair. If AFR is less than 1, then planned expenditures are insufficient, and it is likely that the desired state of good

### Asset Funding Ratio

**The ratio of asset preservation, rehabilitation and replacement funding planned over a 10-year period to the total funding required over the same period to achieve and maintain the agency's desired state of good repair.**

repair will not be maintained. A 10-year horizon is recommended to provide a comprehensive view of how an agency's assets are performing over time.

AFR differs from ASR in what value is used for the denominator of the calculation: funding needed to achieve and maintain the desired state of good repair rather than the cost to maintain current value. In the case that the desired state of good repair is to maintain current conditions, AFR and ASR measure the same thing. However, in other cases AFR better accounts for situations described above that ASR does not address, where the desired condition of the asset inventory is different from current conditions. Note that AFR, as defined, is similar to the Asset Renewal Funding Ratio defined in the AIFMM ***(9)*** and the Asset Sustainability Index as defined by FHWA ***(42)***.

The challenge in using AFR is that it requires an organization to define its "desired state of good repair." FHWA requires that State DOTs quantify this state for their NHS roads and bridges in their NHS TAMP. Also, agencies using the GASB 34 modified approach must define a similar concept, the target level of service for their infrastructure assets. However, it can be difficult to define this desired state or target level of service. Even if it is well defined, it may be difficult to make comparisons between different agencies using the measure, as they are likely to define their desired state differently.  Thus, AFR is a valuable measure for showing whether a given agency is achieving its goals, but of more limited value for making comparisons over time or between agencies.

## Net Present Value

The final measure of interest related to asset value is Net Present Value (NPV). This measure is defined in Chapter 4 as the difference between total discounted benefits of an asset and total discounted costs. When economic value is used as the basis for calculating asset value then the resulting value of an asset is its NPV. If the NPV is positive then the asset or investment is considered worthy of investment. If the NPV is negative then the converse is true, and the cost of the asset is greater than the benefits it is expected to yield to society.

### Net Present Value

**The difference between total discounted benefits and total discounted costs of an asset or investment.**

Where some other basis is used for calculating value, the resulting asset value is analogous to NPV, but cannot be considered to be the same. However, one can still use asset value to support the calculation of NPV when comparing two potential life cycle alternatives. Asset value can support the NPV calculation in two basic ways:

- First, the change in asset value at the end of an analysis period – with discounting applied - can be used to represent the benefits of one investment strategy compared to another.
- Second, the depreciation of an asset each year can be used as a proxy for the

benefits consumed by the asset. This can be significant if one has established a non-linear pattern of benefit consumption as described in Chapter 6, or if an asset is fully depreciated in one of the alternatives being evaluated (in which case it yields no benefits compared to an asset with remaining value).

**Table 7-4** Illustrates the use of asset value in an NPV calculation. The table shows the NPV of an improved asset management strategy, Strategy B, compared to a base case, Strategy A. In Strategy B treatments are performed over the life of an asset, resulting in an increase in cost. With discounting applied, this increased cost total $82 million over 20 years. While Strategy B costs more, it results in greater value at the end of the analysis period: $320 million for Strategy B versus $0 for Strategy A. Applying discounting, the increased value of Strategy B is $146 million. The NPV of Strategy B compared to Strategy A is $64 million, the difference between the increase in value of $146 million and increase in costs of $82 million.

**Table 7-4.** Example NPV Calculation (values in $ millions)

| | A: Base Case | | B: Improved Asset Management | | | |
|---|---|---|---|---|---|---|
| Year | Treatment Cost | Asset | Treatment Cost | Asset | Discount Factor (4% Annual Discount Rate) | Discounted Change in Costs (B-A) |
| 0 | 400 | 400 | 400 | 400 | 1.00 | 0 |
| 7 | 0 | 260 | 20 | 320 | 0.76 | 15 |
| 14 | 0 | 120 | 100 | 380 | 0.58 | 58 |
| 20 | 0 | 0 | 20 | 320 | 0.46 | 9 |
| Discounted Change in Treatment Cost (B-A) | | | | | | 82 |
| Discounted Change in Asset Value (B-A as of the end of the analyis) | | | | | | 146 |
| NPV of Improved Asset Management (Increase in Asset Value – Change in Cost) | | | | | | 64 |

In this example depreciation is assumed to be linear, and thus the same in each alternative. The example excludes consideration of additional factor which may further support an improved asset management approach, such as the increased maintenance cost or potential for asset failure in the case of Strategy A.

## Integrating the Measures

For some applications it can be useful to present a set of multiple measures from the set described above, along with additional context concerning how the measures are defined and should be interpreted. **Table 7-5** provides an example set of calculations.

In this example, an asset inventory has an initial value of $120 million. Accumulated depreciation is $30 million, resulting in a current value of $90 (the initial value less depreciation). Based on these figures the ACR is 0.75, or $90 million divided by $120 million.

**Table 7-5.** Calculation of Value-Related Measures

| Row | Measure | Value | Notes |
|---|---|---|---|
| 1 | Initial Asset Value ($M) | 120 | |
| 2 | Depreciation ($M) | 30 | |
| 3 | Current Asset Value ($M) | 90 | Row 1 minus Row 2 |
| 4 | Cost to Maintain Value ($M) | 5 | Can be calculated based on annual depreciation or using management systems |
| 5 | Cost to Achieve the Desired State of Good Repair Over 10 Years ($M) | 60 | Should be calculated using the agency's management systems |
| 6 | Projected Annual Expenditures | 5 | Can be calculated based on annual depreciation or using management systems |
| 7 | Projected Expenditures Over 10 Years ($M) | 50 | Should be based on the agency's financial plan |
| 8 | Asset Sustainability Ratio (ASR) | 1.00 | Row 6 divided by Row 4 |
| 9 | Asset Consumption Ratio (ACR) | 0.75 | Row 3 divided by Row 1 |
| 10 | Asset Funding Ratio (AFR) | 0.83 | Row 7 divided by Row 5 |

It is further assumed the $5 million is required annually to maintain value, while $60 million would be required over a 10-year period to achieve the desired state of good repair for the agency. The cost to achieve the desired state of good repair averages $6 million per year. This is higher than the cost to maintain value, which would be expected if current conditions were somewhat less than the desired state of good repair. If projected expenditures are $5 million per year, then the ASR is 1.00 and the AFR is 0.83. ASR is calculated by dividing the annual expenditures by the cost to maintain, while ASR is calculated by dividing 10-year expenditures ($50 million) by the 10-year cost to achieve the desired state of good repair.

Chapter 7. Measure Calculation

## Section 7.4

# Practice Assessment

This section provides examples of "emerging," "strengthening," and "advanced" practices for the calculation of value and related measures. In the table an emerging practice is one that supports the guidance with minimal complexity, an advanced practice illustrates a "state of the art" example in which an agency has addressed some aspect of the asset value calculation in a comprehensive manner, and a strengthening practice lies between these two levels.

| Practice Area | Maturity Level | Description |
|---|---|---|
| Current Value Calculation | Emerging | Asset value is calculated for major assets at an aggregate level as required to support financial reporting and TAMP requirements. |
| | Strengthening | Asset value is calculated for major assets. Either the calculations are performed at an asset/component level or supplemental analysis is performed to confirm use of the approach for aggregating asset value calculations. |
| | Advanced | Asset value is calculated for major assets. Either the calculations are performed at an asset/component level or supplemental analysis is performed to confirm use of the approach for aggregating asset value calculations. Sensitivity analyses are periodically conducted to show the effect of changes in key analysis parameters. |
| Balance Sheet Preparation | Emerging | The agency prepares a balance sheet as part of its financial reporting, but does not attempt to reconcile asset value in the financial report with TAM estimates. |
| | Strengthening | Differences in approaches between financial reporting TAM asset valuation are documented as a one-time exercise performed when preparing the TAM asset valuation. |
| | Advanced | Consistent approaches are used where possible to prepare the balance sheet in the agency's financial report and value assets for TAM. Differences in approaches are resolved where possible, and regularly reviewed and documented in financial and TAM reports where they remain. |
| Asset Value-Related Measures | Emerging | Cost to maintain current value, ASR and asset ACR are or can be calculated using annual depreciation and expenditures. |
| | Strengthening | Cost to maintain current value, ASR and asset ACR are or can be calculated using annual depreciation and expenditures. In addition, supplemental analysis is performed using the agency's management systems to establish the cost to maintain current value. |
| | Advanced | Cost to maintain current value, ASR, ACR and AFR are calculated and used to support investment decisions. Supplemental analysis is performed using the agency's management systems to establish the cost to maintain current value and the cost to achieve the desired state of good repair. |