GASB 34: establishing a value for infrastructure assets

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Editor's note: This is a more detailed version of the fourth article in a series about issues raised for local transportation agencies by Governmental Accounting Standards Board Statement No. 34 (GASB 34). The first article was published in the January–February 2000 issue of Technology News. The entire series is available on the Center for Transportation Research and Education's GASB 34 website, *www.ctre.iastate.edu/gasb34/index.htm*.

One of the most complex issues for agencies attempting to comply with GASB 34 is estimating monetary values for infrastructure assets (that is, "capitalizing" assets). Whether an agency chooses to report assets by (1) depreciating their value based on historical costs or (2) using the modified approach outlined in GASB 34 (which applies asset management techniques), ultimately the agency must include the value of its infrastructure assets in its comprehensive financial report.

Unfortunately, little research has been conducted to develop standardized methods for capitalizing infrastructure assets. In this article, we provide two example approaches. The first, relatively simple approach applies the perpetual inventory method (PIM) to depreciate the value of highway infrastructure assets through time. The second example is taken from work done by the California Department of Transportation (CalTrans) to capitalize bridges. This second method is based on engineering measurements of the condition of bridges and requires a bridge management system; such a method would be useful to agencies using GASB 34's modified approach to reporting capital assets.

Perpetual inventory method

The perpetual inventory method, described by Barbara Fraumeni[1], is a depreciation method for valuing capital stock that can be applied to transportation infrastructure assets. PIM accounts for annual capital expenditures and assumes that existing capital assets depreciate in value at a standard rate every year.

The following equation estimates the total value of infrastructure assets on a year-by-year basis:

$$\text{Infrastructure Assets}_{\text{Year}} = \text{Capital Investment}_{\text{year}} + (1 - r)\text{Infrastructure Assets}_{(\text{year}-1)}$$

Where: $\text{Infrastructure Assets}_{\text{year}}$ = the value of infrastructure assets in the current year

$\text{Capital Investment}_{\text{year}}$ = the amount of capital investment in infrastructure assets in the current year

r = the annual depreciation rate of infrastructure assets

$\text{Infrastructure Assets}_{(\text{year}-1)}$ = the value of infrastructure assets in the year immediately prior to the current year

When using this formula, all capital investments should be expressed in constant dollars so that meaningful comparisons can be made across time. Constant dollars exclude inflation and express dollars in terms of a base year.

To apply this formula to transportation infrastructure assets, we need an appropriate annual depreciation rate. Fraumeni's extensive study of highway capital stock conducted for the Bureau of Economic Analysis (BEA) shows that values of existing highway infrastructure assets depreciate by 0.0202 per year. This is a national average that takes into account all types of highway infrastructure (bridges, pavements, rights-of-way, etc.); it may be adjusted for local differences.

The relationship shown in the above equation is recursive—that is, each year's estimate is derived from the prior year's estimate of the depreciated value of infrastructure assets. Therefore, to use this approach, a beginning year (a base year) must be selected and a value of existing infrastructure assets determined for that year. Because GASB 34 requires that agencies eventually use fiscal year ending June 30, 1980, as their base year, we're using 1980 as the base year for our example.

To establish a base year value, we turn to Andrew C. Lemer.[2] Lemer reports that municipalities typically have between $15–35,000 in infrastructure investment (using replacement costs) per resident. Assuming that our example city is on the high side of this range, we start with $30,000 in total infrastructure assets per resident. Given that roughly 65 percent of all public infrastructure investments in streets and highways, we start with roughly $20,000 per resident invested in roadway assets. If our city has 50,000 residents, then it would be reasonable that in base year 1980 it has an investment of $100,000,000 in highways and streets.

Note that in our example the lower annual capital investments in the mid to late 1980s result in a decline in the value of infrastructure assets that continues through the next decade, although the decline is arrested through a large increase in investment.

Note also that a total infrastructure investment of over $35 million over 19 years is required to maintain the value of existing infrastructure assets at a level somewhat close to the value of those assets in 1980.

Table 1 Perpetual Inventory Method Example

Fiscal Year	**Capital Investment during Current Year ($)**	**(1–0.0202) x Infrastructure Assets at the End of Prior Year ($)**	**Estimated Current Infrastructure Assets ($)**
1980	$1,200,000	$100,000,000	$101,200,000
1981	$2,500,000	$99,155,760	$101,655,760
1982	$3,000,000	$99,602,314	$102,602,314
1983	$1,000,000	$100,529,747	$101,529,747
1984	$500,000	$99,478,846	$99,978,846
1985	$800,000	$97,959,273	$98,759,273
1986	$750,000	$96,764,336	$97,514,336

1987	$850,000	$95,544,546	$96,394,546
1988	$700,000	$94,447,377	$95,147,377
1989	$900,000	$93,225,400	$94,125,400
1990	$2,500,000	$92,224,067	$94,724,067
1991	$2,700,000	$92,810,640	$95,510,640
1992	$2,500,000	$93,581,325	$96,081,325
1993	$2,400,000	$94,140,483	$96,540,483
1994	$2,900,000	$94,590,365	$97,490,365
1995	$2,400,000	$95,521,060	$97,921,060
1996	$2,200,000	$95,943,054	$98,143,054
1997	$2,800,000	$96,160,564	$98,960,564
1998	$2,550,000	$96,961,561	$99,511,561
Total	$35,150,000		

CalTrans's approach to valuing infrastructure
Systems for managing assets, like pavement or bridge management systems, have been commercially available to public agencies for almost 20 years and are well understood. These systems generally manage assets based on how investments will affect the assets' condition or performance.

As mentioned in the previous article in this series, such systems for managing assets will generally fulfill the basic requirements of the modified approach: maintaining infrastructure inventories, regularly assessing and rating the condition of infrastructure, and estimating costs to maintain the condition of infrastructure at a prescribed level. They generally do not, however, place a dollar value on assets, as required by GASB 34. To capitalize assets, agencies using such management systems need to take another step: They need to convert their condition or performance ratings to dollar values that can be used in their comprehensive financial reports.

CalTrans has taken that step with its bridge management system.

CalTrans manages its bridges using Pontis (a bridge management system distributed by the American Association of State Highway and Transportation Officials). To use Pontis, bridge inspectors must regularly inspect and rate the condition of the various elements in each bridge. CalTrans has developed a formula for converting the condition ratings for all the elements in a bridge into an overall, current dollar value.

Pontis requires that bridge inspectors evaluate the severity and extent of deterioration to 108 commonly recognized (core) bridge elements (e.g., bridge decks, girders, columns, columns, etc.). When a bridge is inspected, each element's condition is evaluated visually.

Each core element can have from three to five "condition states," with a corresponding evaluation of the extent (percentage) of the condition. Typically the five condition states are as follows:

1. Protected. The element's protective materials or systems (e.g., paint or cathodic protection) are sound and functioning as intended to prevent deterioration of the element.
2. Exposed. The element's protective materials or systems have partially or completely failed (e.g., peeling paint or spalled concrete), leaving the element vulnerable to deterioration.
3. Attacked. The element is experiencing active attack by physical or chemical processes (e.g., corrosion, wood rot, traffic wear-and-tear) but is not yet damaged.
4. Damaged. The element has lost important amounts of material (e.g., steel section loss) such that its serviceability is suspect.
5. Failed. The element no longer serves its intended function (e.g., the bridge must be load posted).

For example, suppose that a bridge has 150 meters of girders; the paint is peeling on 15 meters while the remainder of the paint is intact. The condition of 10 percent of the girders is "exposed," and the condition of 90 percent is "protected."

The first step in translating the condition states into dollar values is weighting the severity of the condition states. CalTrans's severity weighting factors are shown in Table 2. For example, if a core element has three condition states, any proportion of the section rated condition state 3 (the most severe) receives a weighting factor of zero; any proportion rated condition state 2 receives a weighting factor of 50 percent.

Table 2 Severity Weighting Factor (WF)

Number of Possible Condition States	State 1 WF	State 2 WF	State 3 WF	State 4 WF	State 5 WF
3 condition states	1.00	0.50	0.00		
4 condition states	1.00	0.67	0.33	0.00	
5 condition states	1.00	0.75	0.50	0.25	0.00

CalTrans determines the current value of a bridge by calculating a dollar value for each element, based on the weighted condition states, and then adds the element values together. CalTrans uses the equation below:[3]

Current element value = (quantity in condition state • WF • FC)

Where: WF = Weighting factor for the severity of the deterioration as determined by Table 2
FC = Failure cost of the element (cost to rehabilitate or replace an element if it fails

As an illustration, suppose that we are given the data in Table 3: the quantity of each element in each condition state for one bridge. In the right-most column is unit failure cost. (On our example bridge, all 300 square meters of the deck, which has five condition states, is in condition state three (attacked). All 24 meters of joint seal, which has only three conditions states, are in condition state 3, indicating that the joint seal has failed.)

Table 3 Example Bridge CoRe Element Condition and Extent Data

Element	Total Quantity	Units	State 1	State 2	State 3	State 4	State 5	Unit Failure Cost (FC)
Concrete Deck	300	Sq meters			300			$600
Steel Girder	100	Meters	61	34	5			$3,500
Reinforced Concrete Abutment	24	Meters	24					$7,700
Reinforced Concrete Column	4	Each	4					$9,000
Joint Seal	24	Meters			24			$556

In Table 4, the values from Table 3 are used to calculate a value for each element. Then the values of all elements are summed to calculate an estimated value for the entire bridge

Table 4 Bridge Valuation Calculation

Element	Calculation	Current Element Value
Concrete Deck	300 x 0.5 • 600	$90,000
Steel Girder	((61 x 1.0) + (34 x 0.75) + (5 x 0.5)) • 3,500	$311,500
RC Abutment	24 x 1.0 • 7,700	$184,800
RC Column	4 x 1.0 • 9,000	$36,000
Joint Seal	24 x 0.0 • 556	$0.00
	Total Current Value of Bridge:	$622,3000

To obtain a network-level estimate of the value of its bridges, CalTrans adds together the values of all the bridges in its network. That value, together with another measure derived from the bridges' value, is called the health index. The health index is summarized for the entire network or by districts to demonstrate whether the system is improving or deteriorating over time.

Summary

In this article we have briefly summarized two methods for tracking the value of infrastructure assets. Either method would meet the requirements of GASB 34.

Many engineers and public works directors may view asset management and GASB 34 requirements as merely an academic exercise or as an activity that may be handled by their agency's financial officer. However, we would urge public works professionals and engineers to become engaged in the financial reporting of the value of the infrastructure assets they manage. Valuing assets over time (regardless of the method used) reflects how well infrastructure stewardship responsibilities were performed. The outcome could have significant implications on future resources allocated to the management of infrastructure.

The perpetual inventory method (as well as other depreciation-based methods) is a fairly simple approach to satisfying GASB 34 requirements. This method, however, provides only very aggregate, policy-level information. CalTrans's method, although a more complex process, clearly provides information that is more useful to infrastructure asset managers and decision makers. The CalTrans example demonstrates that the process of capitalizing transportation infrastructure assets can be based on sound engineering practices, using asset-by-asset condition information to build a value estimate for an agency's transportation infrastructure network.

[1] Barbara M. Fraumeni, "Strategies for Measuring Productive Highway Capital Stocks," presented to the Transportation Research Board Conference for Information Requirements for Transportation Economic Analysis, Irvine, California, August 1999.

[2] Andrew C. Lemer, "Asset Management: The Newest Thing or Same-old, Same-old?" *APWA Reporter*, June 2000.

[3] Paul D. Thompson and Richard W. Shepard, "AASHTO Commonly Recognized Bridge Elements: Successful Applications and Lessons Learned," presented to the National Workshop on Commonly Recognized Measures for Maintenance, Scottsdale, Arizona, June 2000.