DEPRECIATION OF INFRASTRUCTURE ASSETS

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1. Introduction - Changing Accounting Requirements

Until recently, public sector infrastructure assets were largely left unvalued and their depreciation was not recognised in the accounts of public agencies. When changes to legislation and accounting standards were introduced requiring that infrastructure assets be both valued and depreciated, the natural reaction was to turn to the existing accounting practices in the private sector, where assets have been valued and depreciated for some time, and to attempt to apply those same practices in the public sector. However, infrastructure assets have certain characteristics that are not amenable to traditional formula depreciation methods designed for ordinary assets that may be depreciated to zero,or some salvage value, and then are replaced in their entirety. Infrastructure assets are maintained in operation for long periods of time by virtue of continuous, periodic replacement of parts, or components. They are not replaced in their entirety. Attempts to modify the application of formula depreciation to infrastructure assets by decomposing such assets into their shorter living component parts loses sight of the integral nature of the whole asset and involves extensive information collection that serves no managerial purpose other than to calculate an overall depreciation figure. Yet a less extensive information collection, based on operational knowledge and judgement, would not only produce a better depreciation measure, it could also provide a useful operational and planning tool. This is the rationale for "Condition Based Depreciation for Infrastructure Assets" - to provide more managerial information and a better quality depreciation measure with less resource commitment.

2. Defining an Infrastructure Asset

Not all public sector assets are infrastructure assets so it is important to distinguish the category of public assets to which this depreciation measure applies. Infrastructure assets are defined both in terms of their supply *and* their demand characteristics. Firstly infrastructure assets are "composite assets" - that is they are composed of components of varying physical life spans, which may be individually renewed, thus enabling the life of the whole to be extended. (Hence the example of the 1,000 year old axe that has had 170 new handles and 230 new blades but is "still as good as new!") The composite nature of the

costless spin-off instead of, as today, requiring the investment of extensive time and data collection and manipulation resources.

Having said this, it is recognised that at the moment, while operating engineers are making these judgements as part of their everyday activities, they may not be justifying these judgements by reference to auditable assumptions and standards and they may not be looking forward more than about five years but they should be doing both if they are to be held fully accountable for the viability of the system they are in charge of. This is the area where resources need to be committed if management improvements are to be achieved. The application of effort and resources in these technical areas could do more to improve the service output of assets than current effort expended in calculating depreciation by traditional methods.

8. An illustration of a typical cash flow renewals projection.

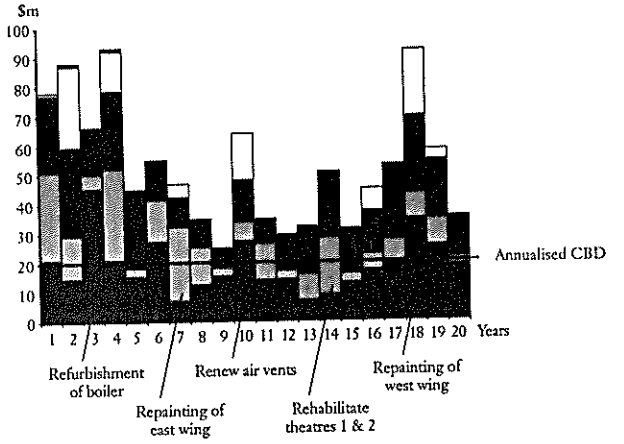

Figure 1: Asset management plan – forward cash budgeting tool and calculation of condition-based depreciation

9. How CBD is addressed in the Accounts.

The NPV of the future cash flow projection for renewals expenses is calculated as an annuity. This represents the amount that would need to be put aside each year to maintain the asset value. If less than this is actually spent on renewals (maintenance, repair, replacement of components), the difference becomes a charge against the income and expenditure account for "asset restoration". (There is a negative charge when the actual amount spent on renewals is larger than the calculated annuity.) This is the system which is

asset makes it possible to extend its overall operating life, but what makes this desirable is that the *demand* for the service that the asset provides should be an ongoing one.

Thus the definition of an infrastructure asset is that
(a) it is a "composite asset" where the life of the whole may be infinitely extended by replacement of component parts, and
(b) the "demand" for the service that the asset renders makes this desirable by being such that no end to the service requirement is currently envisaged.

The importance of the second part of the definition is that any "infrastructure asset" immediately becomes an "ordinary asset" as soon as an end to its service use is planned. Thus, if one should plan to decommission a dam, a sewerage network or a road, within the current planning period (say within the next 10 to 20 years), then that asset ceases to be an infrastructure asset - one that is maintained and renewed to ensure an infinite life - but instead is managed so as to run its value down over the residual life left to it. Depreciation in this case then reflects this run down, as in the case of any ordinary asset.

3. Defining Depreciation.

Depreciation is held to represent the reduction in the service value of the asset. If the asset is maintained (through continuous component replacement) such as to preserve the service value of the asset into the foreseeable future, then one could argue that infrastructure assets do not depreciate. This is, however, not entirely true and for two reasons.

The first is that the component replacement, which, in effect, makes good the "wear and tear" element of asset depreciation, occurs in a lumpy fashion, not smoothly over time. Thus the asset would be expected to accumulate depreciation for a period of time before being brought back up to scratch by some repair, renovation, component replacement or refurbishment. It is necessary to have a means of recording both the reduction in service value brought about by wear and tear *and* the restoration of service value provided by component replacement,etc. so that, at any point in time, the value of the asset may be tracked and, in particular, that management may be held accountable.

But wear and tear is only one component of depreciation. The other is obsolescence, brought about by a number of factors (eg changes in demand for the services the asset provides, changes in environmental or operating standards, changes in technology, etc.) With infrastructure assets, demand obsolescence is typically very low. This is, in fact, what makes it possible to predict the continuance of demand out many years. However, even though slow, it is nevertheless real. It is in order to capture this element of depreciation that, even though the asset can be maintained in *physical* operating order almost infinitely through component replacement, that, nevertheless, it is considered

prudent to capture the demand obsolescence by placing a finite, although quite long, life on the asset. Thus an infrastructure asset such as a dam or an irrigation network may be assumed to have a life of say 150 to 200 years. Applying this demand obsolescence element of depreciation would mean allowing an obsolescence factor of about 0.5 to 0.7 of one percent of replacement value. This may also be considered equivalent to taking into account renewals occurring beyond the planning horizon of ten to twenty years.

4. Condition Based Depreciation - The renewal element.

The renewal element of infrastructure is the critical element that needs to be both measured and managed. In the Condition Based Depreciation (CBD) approach, it is calculated by developing a forward cash flow projection over a reasonable period of time (this is based on the nature of the infrastructure asset being considered, for water a 20 year forward period would be reasonable).

This cash flow is based on a technical estimation of what activities would be necessary to be carried out on the infrastructure in order to maintain the same level of service for the same potential customer base over the planning period. Thus, for example, technical requirements may be that channel relining is necessary for a certain section within the next five years, that certain pumps need replacement in about ten years, and so on. Each of these replacement activities would be based on technical assumptions about the residual economic lives of pumps, the operating and demand conditions of the system, etc, *which would be written down and technically audited.*

A forward cash flow projection for renewal activities that will maintain the service capacity of the asset is thus essentially an operational and planning tool for asset managers. But it can do more. A comparison of the net present value of the cash flow projection at the beginning and end of the year represents the change in asset value that has occurred over the year. If the NPV of future renewals has increased, this represents a fall in asset values of the same amount. Similarly if, through a periodic replacement activity, the NPV of future renewals should fall, then the asset values will rise to represent the making good of past wear and tear. The best measure of depreciation is the cost of making good the accumulated wear and tear, because this is a direct measure based on change of condition of the asset.

In summary, Condition Based Depreciation (CBD) consists of
1. Technical (engineering, operational) assessments, and
2. Financial estimates, which together produce the
3. Cash Flow Forecasts, which are then subjected to the
4. Calculation of Net Present Values

5. Linking Maintenance and Depreciation.

It is not possible to define the economic life of any asset (infrastructure or non-infrastructure asset) without reference to the maintenance strategy that is assumed to be operating. Thus a motor car may last for seven years with appropriate maintenance but may fall apart in two without. The rate at which an asset depreciates is critically dependent on the maintenance strategy employed. Yet in most accounting regimes depreciation is determined independently of the maintenance applied, so that one may have a situation in which maintenance is reduced but the resulting increased asset deterioration is not reflected in the measure of depreciation, thus making the profit and loss situation look better and providing an incentive for management to underperform on maintenance. This situation, which is not in interests of the community, does not happen with condition based depreciation. It is not possible to improve the current profit and loss position by reducing maintenance expenditures at the expense of future costs, for these future costs are simultaneously being picked up in the depreciation charges. Thus CBD provides an incentive for responsible management of infrastructure assets - as an accountability tool.

6. A Planning Management Tool.

CBD can be extended as *planning management tool* by the addition of projections of future capital cash flows for enhancement and extension. Enhancement is defined as an increase in service for a given customer base and extension is defined as an increase in the customer base for a given service standard. New *capital works* could have elements of both enhancement and extension and any *asset activity* could have elements of renewal and new capital works.

By combining both renewal and new capital projections in the cash flow, the possibility arises for using the projections for the development of "what if" scenarios. Thus, one can calculate the impact on future extension work if money is spent today on increasing the utilisation of existing assets. In this way it is possible to measure the benefits (in NPV terms) of asset management activities. Asset management can be measured by the reduction in (a) depreciation and (b) new capital works, which is brought about as a result of asset management actions. Many agencies have a goal for "wise asset management" but few have a means of measuring the satisfaction of this goal. This extension to the renewals projections would provide such a measure.

7. Resource Requirements

It should be pointed out that the development of such forward cash flow projections (both for renewals and for capital works) is part of the ordinary requirements of good management. It is not additional to those requirements. Once the management tool is established, depreciation can be calculated as a

currently operated by the Road Traffic Authority in New South Wales which operates a condition based depreciation system.

Suppose that the annuity is $300m and the actual renewal expenses in the year were $250m. $50m (the difference between the two) would then be a charge on the "asset restoration" account. This would show up in both the Income and Expenditure Statement and in the Balance Sheet in the following way:

In the Income and Expenditure statement there would be:

Expenditure

Upkeep (or renewals)	$250m
Provision for asset restoration	$ 50m

and in the Balance Sheet, this would be shown as a fall in the value of the assets, thus,

Assets

Assets	$xm
less Provision for Asset Restoration	$50m
= written down asset value	

Some Questions - and Answers

Below we address some of the questions that may be asked of CBD.

How does CBD relate to asset valuation?

Because CBD is a direct assessment depreciation method based on the condition of the asset itself and the estimated cost of retaining the current service level, it is independent of the actual valuation method employed. Following the "Deprival Value" precepts, the appropriate valuation method for infrastructure assets which have an ongoing demand, is a form of replacement value, but whether the modern equivalent value is adopted or some form of optimised value (whereby the costs of past mistakes in overdesign or overcapacity are recognised as a loss in value up front) depreciation can still be calculated by the CBD approach. In fact if the optimised value is adopted as the appropriate value for the purpose of rate of return calculation and is much lower than the replacement value, CBD provides a means of ensuring that sufficient is allocated for renewals.

How long should the forecast period be?

It is suggested that a period of about 20 - 30 years will generally be appropriate for most assets. Where planning periods are typically 30 years, as in the electricity industry, 30 years would be appropriate also for the renewals forecast projection period. In other cases, such as water, 20 years may be appropriate. Not much is gained by going far beyond 20 years because of declining accuracy of assessment and the slight difference that the calculations will make to the total NPV. With a period of 20 years, even quite large replacement elements occurring in the 20th year will make relatively little change to the 20 year NPV annuity, thus retaining some stability in the depreciation allowances - a desirable factor. With short periods, such as 5 to 10 years, normal fluctuations in renewals patterns can lead to more unstable depreciation allowances. Shorter periods also do not allow as much preparation and planning time for larger renewal expenditures.

Why NPV? What discount rate?

The use of NPV and annuities allows for the fact that the amounts raised now for renewals expenditures will be invested until needed. Normally the forward cash flows will be developed in real terms to avoid the double guessing involved in also having to project inflation rates. If this is the case then the discount rate to be used should be the real discount rate. Sensitivity analysis can be carried out to determine the effects of different discount rates. The appropriate rate is the rate at which the annuities will be invested.

What about the costs incurred beyond the forecast period?

If we only take into account the next 20 years, what happens to the costs of renewal in years past 20?

(1) The 20 year forecast period is calculated on a rolling basis, every one, three or five years as is deemed appropriate. Thus future costs are always being brought to account. Renewal costs more than 20 years out, with current levels of real interest rates, would in any case have little real impact on NPV and annuities.
(2) The "obsolescence" factor referred to earlier which allows for gradual technical and demand obsolescence, may also be considered to take into account in some way later renewal expenses.

This two part depreciation system is employed by the Road Traffic Authority and by the NSW Treasury in its currently proposed "deferred maintenance" approach. The"deferred maintenance" is similar to the forecast renewals expenditures except that it looks forward a shorter time period. The NSW Treasury is currently considering extending the time period to bring it into line with the condition based depreciation approach.

What controls are there on agencies to use funds raised by depreciation charges for the purposes for which they were intended?

This is essentially not a question of the depreciation method itself but of financial probity on the part of agencies. In the UK, the water industry, which has adopted an approach similar to CBD is now considering shortening the time period over which depreciation is calculated because they fear that the money is not being spent for the purposes for which it was raised. This largely defeats the purpose of ensuring viability of asset systems and the equitable allocation of charges over all consumers. The answer lies in the technical audits required by the CBD approach - all the assumptions that lie behind the cashflow projections are subject to independent technical audit - and in the detail of the cashflow projections themselves which act as a check on the behaviour of agencies. If agencies do not spend according to their own projections they need to account for the changes.

What is the impact on pricing and equity?

The CBD approach would result in new systems paying less for their renewals annuity than older systems nearing refurbishment. This could be advantageous as the interest component on new systems is much higher than that of older systems and depreciation will thus act as an offset in the total charge. This means that the overall charges for old and new systems may not be as different as looking merely at the depreciation charge might suggest.

Where older systems have not provided for renewal funds, the advanced state of deterioration will lead to a reduction in the sale value of land connected to that system, since purchasers realise that they will themselves need to pay for renewal of the system. Thus new purchasers of land in the older irrigation systems will be able to offset the higher depreciation charges against the lower purchase cost.

Existing holders of land will pay more for depreciation than landholders in a newer irrigation system but this is in lieu of their having had to pay out the money before and it is generally considered desirable to pay out later rather than sooner.

An advantage of the CBD approach is that depreciation is based on actual expenditure projections closer to the time of spending when changes in technology are known, rather than, as in traditional methods, providing some 80 to 100 years ahead of time. Not only are the charges likely to be more realistic, they are also likely to be more acceptable to the consumer - since they can be validated.

How will Victoria's "no borrowing" rule impact?

The annuity approach requires that an average rate is struck and that in years in which this is greater than expenses, the difference will be invested. In years in which the expenses are greater than the annuity plus investments, the shortfall will be borrowed. A blanket "no borrowing" rule would make the operation of the annuity system very difficult. However, if the technical audits supporting the renewals projections are accepted, they may constitute a good case for allowing borrowing in those periods when it is necessary.

Will the Auditor General accept it?

In principal, the condition based approach to depreciation is no different from the fund approach to superannuation. Actuarial studies have proceeded much further in the development of estimates of human life than have technical studies of asset lives, which are inherently more variable, but in principle the approach is the same. Both involve technical assumptions and financial estimates. The Auditor General accepts actuarial studies as a basis for superannuation charges. In general the Auditor General is always prepared to accept the professional advice of an independent specialist. In NSW the Auditor General has accepted this approach for the RTA, in the UK the Auditor General has accepted it for the water industry.