Common Sense and Asset Management

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Many utilities expanded and built new water and wastewater facilities during the late 1970s and early 1980s to meet changing regulatory requirements and increased demands. The federal government funded a large portion of these expansion projects. Now, some 25 to 30 years later, utilities are recognizing the need to renew and replace (R&R) their facilities.

Presently the federal government estimates it will fund only half the anticipated R&R needs during the next five years, putting significant pressure on utility managers to plan for and fund R&R expenditures. A properly designed and implemented asset-management system should provide utility managers with the tools needed to:

- minimize costly emergency repairs
- make strategic funding decisions designed to keep rates low and bond ratings high
- measure the efficiency and effectiveness of their maintenance program
- defend and protect cash reserves for future asset R&R expenditures
- meet new accounting (GASB 34) and environmental (CMOM) regulatory standards

Concerns about the accounting requirements of GASB 34 and regulatory requirements of the United States Environmental Protection Agency's CMOM program are fueling interest in asset management. Many computer software programs exist that collect, integrate, and assist in the analysis of large amounts of interrelated data, which is a requirement of an asset-management system.

Managers recognize that the cost to purchase, install, train, and maintain the data in these programs can be significant, but many of them may have difficulty understanding the value of such systems for their particular utility. This article will provide the context within which the utility manager can evaluate his or her utility's existing systems and tailor an asset-management program that is meaningful and cost-effective.

Good asset management requires taking an asset-centric, life-cycle approach to managing the assets that optimally balances corrective and preventive maintenance with renewal and replacement of assets for cost effectiveness. A key element to this approach is to develop R&R planning that involves both strategic and tactical levels. This proactive R&R planning approach involves the following topics:

- Asset Life Cycle
- Life of a Utility
- Strategic R&R Planning
- Tactical R&R Planning

The section of this article that focuses on the asset life cycle highlights normal maintenance activity and the opportunity to optimize the asset investment by proactively planning R&R projects. The section on the life of the utility stresses understanding the utility's maturity and character, which is important in strategic, long-range financial planning. In addition, some guidelines are presented for estimating long-term R&R needs. The strategic and tactical planning sections will describe some basic goals, tools, methods, and benefits to be derived from both of these planning phases.

Life Cycle of an Asset

Every asset has a beginning and a useful life, and at some point it must be replaced and disposed of, as shown in **Figure 1**. A generalized survival function curve showing the asset condition as a function of time is illustrated in **Figure 2**, which shows the gradual deterioration of the ability of the asset to provide service, compared with the straight-line depreciation for that asset.

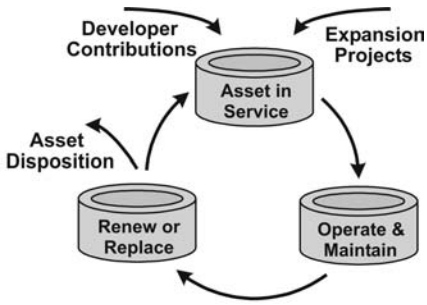

Figure 1. Asset Life Cycle Schematic

Note that as the asset ages, the rate of deterioration of the asset increases. The effect is to cause the normal maintenance costs of the asset to increase with age. At some point the asset can no longer provide the level of service established for it. This is the "design life" or "useful life" of the asset.

"Design life" is defined as the original useful life of the asset as estimated by the design engineer. "Useful Life" is defined as remaining useful life of the asset and changes over time based on levels of maintenance, conditions of service, and other factors. At the startup of the asset, the useful life is the same as the design life.

The generalized curve in Figure 2 shows the deterioration of the asset, including normal maintenance activities. Any work performed on the asset that is not considered normal maintenance, but rather renewal or rehabilitation, will change the shape of the curve and increase the useful life of the asset. At the end of its useful life, the asset must be replaced or the service provided by that asset must be provided by alternative means.

The top curve in Figure 2 depicts a possible curve resulting from a renewal and replacement alternative, compared to replacing the asset at the end of its useful life. It is possible that the overall life-cycle cost of an asset can be lower if the asset is renewed, thus increasing its useful life, compared to replacing the asset at the end of its design life. Part of the common-sense approach is to anticipate when an asset will need to be replaced and to anticipate that need far enough in advance to be able to analyze the alternatives to replacement.

The useful life of an asset is affected by many variables. Assumptions made during the planning and design of the original asset may not actually prove true. Equipment quality may not be as specified, process conditions may dramatically change, or funding and budget constraints may require changes in maintenance levels. A good asset-management system will help managers track the actual condition of the asset, anticipate the need for

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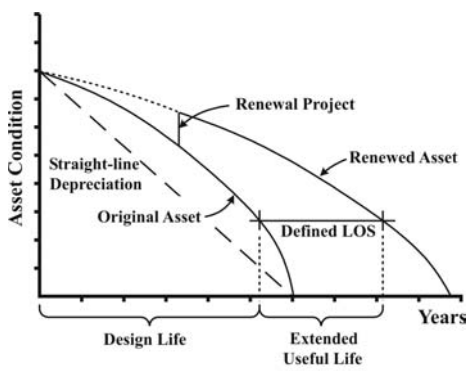

Figure 2. Asset Condition vs. Time

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renewal and replacement, and evaluate which course of action is most cost-effective.

Life of a Utility

An important aspect of proactive R&R planning is to understand the overall life of the utility. This concept includes having a general estimate of how old the utility is and the composite, useful life cycle of the utility. Understanding the shape of a utility's life-cycle curve and where the utility is on that curve is the underpinning of strategic R&R planning.

Each utility consists of a large number of individual assets, each having its own value, function, and useful life. Assets are added to the utility over time to meet growth, changing technology, and regulatory requirements. Every asset has a unique life-cycle curve. Added together, the asset life-cycle curves create a composite life-cycle curve for the utility.

A utility's idealized life-cycle curve, based on the fixed-asset value (in constant dollars) of the utility over time, is shown in **Figure 3**. Initially, the utility capital improvement program, or CIP, is primarily comprised of expansion projects that add new capacity to the utility. As the utility matures, more and more of the assets require renewal and eventually replacement.

As the utility approaches buildout, most of the capital expenditures are devoted to R&R projects, as shown in **Figure 4**. This shift to more R&R expenditures requires a shift in strategy and planning focus.

Renewal and Replacement (R&R) Planning

Common sense suggests that effective R&R planning is necessary to anticipate R&R needs in time to maintain the defined level of service cost-effectively. Cost-effective projects require time to evaluate alternatives, plan, design, and construct–typically from one to three years. Reactively delivering R&R projects usually does not allow time to evaluate less costly alternatives; thus, good R&R planning should proactively identify assets that need some level of renewal and replacement

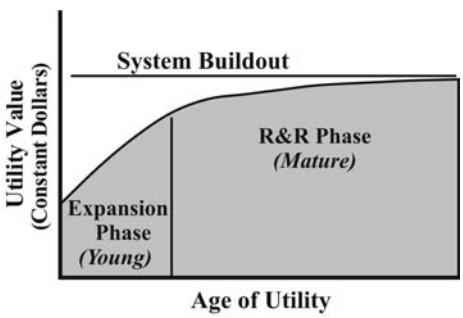

Figure 3. Life of a Utiliy

at least one to three years prior to reaching their useful lives.

Proactive R&R planning is more, however. It starts during the conception and design of the original assets and identification of the service to be provided. Decisions related to operations and normal maintenance activities, versus renewal and replacement activities, should be made at that time.

Ideally, the manufacturer or design engineer should define the operating and maintenance activities for the asset in the O&M manual. The quality of the O&M manual and the "plan" for operating and maintaining the individual asset is fundamental. A financial plan that adequately funds R&R projects extending as much as 20 to 40 years into the future is also needed. In addition, methods for project delivery must be considered.

Detailing all the management activities required to properly and cost-effectively plan for R&R projects is too broad a subject for this article. Instead, we will deal with some basic elements that require the most attention from utility management in order to refocus resources toward planning for R&R projects and realize the benefits of a good asset-management system.

R&R planning can be divided into three phases: reactive R&R, tactical R&R planning, and strategic R&R planning. Each phase requires a certain mindset or planning philosophy, in addition to certain tools to properly perform the planning function.

Most utilities are familiar with the philosophy and requirements of reactive R&R, so we will not focus on the reactive phase of R&R planning, except to emphasize that it is difficult to "guess" long-term annual expenditure needs and how to fund them using reactive R&R history. Instead, we will focus on the strategic and tactical phases of R&R planning. A time frame and a summary of characteristics of each planning phase are illustrated in **Figure 5**.

Strategic R&R Planning

The term "strategic" implies a high level of thought and a broad view of what needs to be accomplished. The strategic approach should create the future conditions most favorable to implement the utility's plan. For utility asset management, this means having:

- a general understanding of growth and replacement needs
- a plan for providing the resources, both money and people, at the time they are needed
- the ability to communicate that plan to the governing authorities

The R&R strategic plan should be a component of the utility's strategic business plan or guiding document. The most significant aspects of the strategic R&R plan are the financial projection to deliver R&R projects and the subsequent funding plan for those financial needs. The funding plan must consider the impact to user rates.

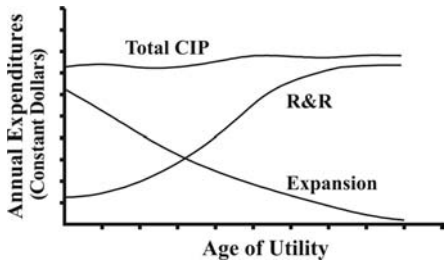

Figure 4. Comparison of Expansion vs. R&R Expenditures over time

Other elements of a strategic R&R plan include establishment of appropriate levels of service, performance measures, and auditing practices. It is recommended that the utility update its strategic R&R plan at least every five years. The strategic plan should provide a clear philosophy for distinguishing maintenance versus R&R activities to cost-effectively extend the life of an asset. This philosophy should be used by all entities that plan, design, and construct assets that will be added to the system.

In preparing a strategic financial plan, the utility manager will need to estimate:

- the value of the system or group of assets (typically expressed as replacement cost new)
- a composite, cost-weighted useful life of the system or group of assets
- an "in-service" date for the system or group of assets
- a funding strategy

A strategic R&R financial plan considers the system or group of assets as a single, combined asset and estimates annual R&R expenditures. An initial projection of annual R&R expenditures is based on an estimate of replacement cost new (value of the system) and a cost-weighted, composite useful life of the system or group of assets.

Determining funding strategies to meet the R&R needs and all other utility funding needs completes the financial plan. The funding strategy may be modified to make the accumulation of reserves more defensible to the utility's governing body, depending on the composite age of the group of assets. Modifying the funding strategy involves using the estimated "in-service" date of the group of assets.

VALUE OF THE SYSTEM

The utility may already have an asset record that fairly approximates the value of the system. The utility manager should determine the appropriate level of detail needed to make a defensible case for financial planning.

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In the event that an adequate asset record is not available, an asset valuation task can be performed. The level of detail of the valuation can vary, depending on the size and complexity of the groups of assets. The goal is not to create a precise estimate of the value of the system, but to develop an approximate estimate. The assumptions and values that are used to formulate the financial plan can be validated and updated later with more detailed information as it becomes available.

COST-WEIGHTED, COMPOSITE USEFUL LIFE AND IN-SERVICE DATE

The composite useful life should be weighted by cost, using the values obtained in the valuation described above or the existing asset record, depending on the manager's confidence in the asset record. Typical useful lives for groups of assets can be obtained from various published sources, such as the Uniform System of Accounts series for water and wastewater utilities, published by the National Association of Regulatory Utility Commissioners (NARUC), and Section 25-30.140 of the Florida Administrative Code. As with the estimated value of the groups of assets, the goal is to determine a reasonably accurate estimate of the composite useful life that can be modified later, based on improved information.

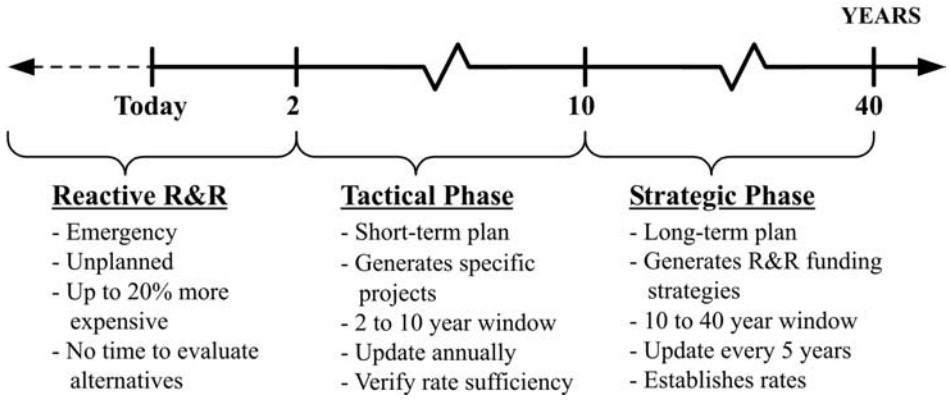
An estimate of the composite "in-service" date for the group of assets should also be determined at this time. This estimate can be the most difficult to obtain. As before, if the existing asset record is adequate, then a composite in-service date is easy to derive. For the general strategic-planning time frame, it is appropriate to base an estimate of the in-service date for a group of assets on personal or anecdotal experience. Again, the assumptions should be modified as necessary as new information becomes available. The in-service date and the shape of the life-cycle curve for the utility will allow the modification of the projections of R&R expenditures and thus the funding strategy.

INITIAL PROJECTION OF ANNUAL R&R EXPENDITURES

The following guidelines can be used by the utility manager to develop an initial projection of annual R&R expenditures for the 10-to-40-year strategic time frame. This initial estimate can then be modified as necessary to help the utility manager establish or defend a funding strategy.

In a fully mature, ideal system, annual R&R expenditures would theoretically be equal to the weighted annual depreciation expense for all fixed assets, as adjusted for inflation. Because of the variability in expenditures, however, in order to meet a high percentage of the annual needs, deposits should be set at some value in excess of this theoretical value–say 10 percent to 50 percent.

Figure 5. R&R Planning Time Frame – Phases & Characteristics



The excess percentage used should be influenced by both historical variability of actual R&R expenditures and predicted future R&R needs. Interest earnings on the R&R fund, if retained in the fund, can effectively provide a portion of the excess percentage. Planning for R&R expenditures at these relatively constant levels over time is very important for estimating revenue requirements from the standpoint of determining required rates or sufficiency of existing rates.

Let's consider an example: We will develop an initial estimate of annual R&R expenditures needs for a utility that has an estimated overall replacement cost new value of $100 million and a composite, cost-weighted useful life of 25 years. We will keep the example simple by considering the entire utility, rather than grouping assets and assuming that the retained interest earnings will be enough to fund the expenditure spikes. An estimate of the annual depreciation expense is therefore 1/25th, or 4 percent, of $100 million–or approximately $4 million per year on average needed for R&R expenditures.

This method estimates a worst-case, baseline projection of annual R&R expenditures based on replacing the entire utility once every 25 years. If needed, the projections can be modified using this baseline as a starting point.

FUNDING STRATEGIES AND MODIFYING THE R&R NEEDS PROJECTIONS

A number of fairly young utilities may find themselves in a situation in which their composite service age is midway on the life-cycle curve. Their capital expenditures are still primarily for expansion projects, and their accumulated reserves appear inordinately high for the next several years because R&R spending has not caught up to the set-asides as determined in the initial estimate described above.

Because of the nature of the estimating methodology, the utility manager can modify projected R&R needs so that he or she forecasts fewer needs in early years ramping up to the steady-state level of the annual depreciation level. This modification can be made only if the utility is still relatively young. The modification is based on the deterioration characteristics of all physical assets and the composite nature of the calculation.

The annual depreciation method is appropriate for a mature utility that has reached or soon will reach buildout. This number can also be used to estimate ultimate R&R needs. The modified method is good for a young utility that is still growing. In order to properly apply the modification, the average in-service date for the system or group of assets must be estimated in order to locate where on the curve the utility currently exists.

The modified method will show smaller R&R needs in the shorter planning time frame, freeing up the revenues generated by existing rates to be used for some other need. It can also help defer rate increases. Obviously, a higher level of effort is required to modify the initial R&R needs projections. In the event that an accurate asset record exists or is created and accurately maintained, these calculations are very easy to obtain.

This method can help the utility develop a strategy to transition from a debt-financed to a pay-as-you-go funding strategy by minimizing R&R deposits during the term of the bonded indebtedness. When debt has been retired, the portion of the utility's revenues allocated to pay the debt service can be reallocated to deposits to meet R&R needs.

It is important to plan for and set aside money for emergency R&R expenditures. There is typically a bond covenant requirement of 5 percent of annual gross revenues for annual R&R deposits. This level may meet emergency R&R needs, but the ultimate, buildout, annual R&R deposit requirements may be as high as 20 percent of annual gross revenues.

For the strategic approach, we recommend dividing the utility into two major groups of assets: short-lived and long-lived.

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Short-lived assets would generally include pumps, mechanical and electrical equipment, and other assets that have useful lives shorter than 15 to 20 years. Long-lived assets generally include structures, pipes, and other assets that have useful lives longer than 15 to 20 years. If the utility provides more than one service, we recommend further dividing the groups of assets, based on utility service as well.

Tactical R&R Planning

Tactical R&R planning should proactively identify specific assets needing R&R, evaluate R&R alternatives, and initiate R&R projects for inclusion in the utility's CIP. The ultimate goal for an R&R planning group is to identify R&R projects two to 10 years ahead of the asset's reaching the end of its useful life. Depending on the utility's resources and the accuracy of the asset record, a realistic initial time frame may only be from one to five years. Tactical R&R planning activities also should include a process to gradually improve the accuracy of the asset record.

Basic Elements of Tactical R&R Planning

The basic elements needed for tactical R&R planning are relatively simple and easily understood. They include:

- an accurate asset record
- an annual R&R planning process
- methodologies for delivering R&R projects
- R&R project closeout procedures for updating the asset record, which leads to
- an accurate asset record

Accurate Asset Record

An accurate, sufficiently detailed asset record is essential to effective proactive planning of R&R projects during the tactical phase. Such a record meets the reporting requirements of GASB 34 and provides the utility manager with information for both tactical phase planning and strategic planning. The minimum requirements of an asset record are:

- asset name and classifications
- asset install and in-use dates
- design useful life
- original cost

Classification information that increases the effectiveness of the asset management system includes:

- asset location
- asset function
- political district
- service type
- service area or district

Other pertinent information may be collected and recorded as determined by the utility. Obviously, the more information in the record, the higher the cost to maintain the record and the higher the risk of inaccuracies. The asset maintenance history is an essential part of the asset record and is not mentioned here because the concepts are discussed in greater detail in articles concerning computerized maintenance management systems.

Annual R&R Planning Process

We recommend that a utility have a formalized, annual R&R planning process that is coordinated with the utility's CIP budget process. The following activities are the core of the tactical R&R planning approach, and are generally in sequential order:

- generation of a list of assets within a defined percentage of their design useful life
- solicitation of feedback from the utility's O&M staff to add to or modify asset list
- inspection to verify and observe condition of assets
- preliminary evaluation of R&R alternatives
- preparation of proposed R&R project list
- prioritization of proposed R&R project list
- determination of project delivery methodology
- preparation of preliminary budget and schedule

The list of assets that are within a defined percentage, but no less than two years, of the end of their design lives can be reported to the planning engineer from the asset record. Depending on the amount of information in the record, the planning engineer may be able to analyze the maintenance history and make decisions on renewal and replacement needs.

The planning engineer should solicit feedback from O&M personnel regarding the list of assets in order to verify that the data are accurate and the information regarding the condition of each asset is current. The O&M staff should recommend additions or modifications to the proposed asset list.

Based on the list and feedback from the O&M staff, the planning engineer should inspect the assets remaining on the list. The inspections should help determine the current condition and relative urgency to rehabilitate or replace each asset. Also, the engineer should evaluate renewal alternatives to replacement.

A list of R&R projects can then be generated or modified from the previous year and relative priorities can be established, based on cost and risk factors. At that time, the utility management staff can decide on the project delivery methodology, either by O&M forces or by the utility's CIP.

The final step in the annual planning process is to create or update a project's schedule and budget. The utility's CIP budget process will determine sufficiency of funds, but if the strategic R&R planning and the tactical R&R planning phases are working properly, funding should be available.

Project Delivery Methodologies

Project delivery is not necessarily a planning activity but an implementation activity; however, deciding how to deliver an R&R project can affect the tactical planning process–in particular, the budgeting needs of the tactical plan. Some R&R projects will be small and can be delivered in the O&M budget.

The decision to deliver the project as a CIP project or as an O&M project depends on the organization of the utility. Most utilities have O&M staff who are capable of handling normal maintenance and small R&R-type projects. A reasonable guide for determining project-delivery methodology is that if the cost is greater than $200,000, the project would usually be delivered by the CIP. If the project cost is less than $10,000 it would usually be delivered by the O&M forces.

There is a master project delivery concept that can be used to budget and deliver the $10,000 to $200,000 range of projects. This concept creates a CIP master project at some predetermined funding rate, say $1 million annually, that is approved by the governing agency. Smaller R&R projects that qualify to be included in the master project can be added and implemented by the CIP staff in a relatively short period of time.

This mechanism can deliver the mid-sized projects within the zero to two-year budget time frame as well. These master projects can work well for delivering the unavoidable, unplanned R&R projects that will always crop up.

R&R Project Closeout Activities

R&R project closeout activities are not really a planning activity but an implementation activity. Whenever any project is completed by the utility's forces or contributed by a developer, the R&R project closeout activities will add the appropriate asset information to the utility's asset record. These activities include a step to account for retiring the existing asset. The asset acquisition activities are the most crucial step in maintaining an accurate asset record and are also the key to gradually populating a new asset record for the database.

Conclusion

With the maturing of many utilities, the focus of management should now properly include more emphasis on the planning and delivery of R&R projects. The concepts, tools, and practical techniques for implementing a cost-effective, comprehensive R&R program are applicable to all environmental utilities, regardless of size. It is likely that in the future, utility managers will be judged by how well and efficiently they are able to plan and deliver their R&R projects.