Life Cycle Costing: Getting Approval for the Budget You Need

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Facilities officers are faced with an increasing need to rigorously justify budgets for services they provide to the academic community. Construction, maintenance, operations, and renewal of physical plant resources must be evaluated in a value added context that accurately accounts for all costs related to providing those services. Life Cycle Costing provides an excellent means to meet these needs.

This paper will explain and employ a combination of life cycle costing and computer spreadsheet techniques to develop a costing procedure for evaluating the initial, annual, and long-term costs of constructing, operating, maintaining, and eventually renewing a facility. Uses of the information will be explained to include total costing of design options, preparation of accurate and justifiable annual budgets, intermediate and long range budget planning and programming for capital improvements, deferred maintenance requirements, preventive maintenance requirements, utilities costing, and custodial needs of virtually any facility within an institution.

To begin, what is life cycle costing and why is it important? Essentially, life cycle costing is the process of determining the combination of funds that must be: (1) spent annually to operate and maintain a facility and (2) set aside annually to eventually renew the facility's components as they deteriorate over time.

The life cycle costing process is important for three reasons.

First, in developing a budget for a proposed construction or renovation project, the process provides a logical method for accurately determining the true cost of the project to include the maintenance, operating, and renewal costs once the project is completed. Accuracy and completeness of the information can assist immeasurably in establishing a facility officer's credibility early on. This will lead to trust on other issues at critical points later in the project.

During the design stage, the process is useful in assessing the validity of various design options. For example, is the architect specifying building components such as window units on the basis of habit and familiarity with the product, or is his or her choice based on a cost analysis of programmatic needs, environmental considerations, and the construction budget? Usually the actual rationale discovered after the fact, or at best, during a frantic (and sometimes irrational) round of cost cutting to return to budget realities prior to releasing the project for bidding purposes.

A third reason for the importance of life cycle costing pertains to existing facilities. The process provides an effective means of translating rather abstractly stated maintenance, operations, and renewal needs into dollars and subsequently assessing the risks of not accommodating those needs. In doing so, the two questions asked most frequently of facilities officers can be answered—how much will it cost and what are the consequences of not accommodating the needs?

Simply put, life cycle costing is important because it provides a relatively accurate, complete means of determining the total cost of planned or existing facilities and allows the logical setting of priorities for maintenance, operations, and renewal of those facilities.

Life cycle costing involves four basic cost elements associated with almost any building: facility renewal, preventive maintenance, custodial services, and utilities costs. In discussing the renewal component, there are at least two separate situations in which life cycle costing techniques can be applied. The first situation addresses new construction, and the second deals with on-going renewal of an older facility. The case of new construction will first be explained to demonstrate the procedure. Application of the costing procedure in budgeting for renewal of an existing facility will then be explained. Subsequently, the procedure will be applied to annual costing of preventive maintenance, custodial services, and utilities. Note that these latter cost components are equally applicable to newly constructed facilities as well as older ones.

Step 1: Obtaining the Data

The first step in developing life cycle costs for a new facility is to gather three data elements for each building component that will be replaced or renewed over time. First, we must know the cost of the building components. Second, we must know the expected useful life of those components. Finally, we must know the approximate percentage of a component that will be eligible for renewal.

Building component costs for a new facility can be determined rather easily because we have the Schedule of Values that was submitted by the contractor and approved by the architect or engineer before project construction commenced. The Schedule of Values, of course, specifies what the contractor is charging for all materials and labor that are used in constructing the facility. Normally, the listing should be detailed enough to determine the cost of each building component such as air handlers, ducting, masonry, exhaust fans, wall finishes, carpet, etc. Since this is what we paid for the materials and labor, it is highly accurate data to use in determining the cost of replacing or renewing the components at the end of their useful service life.

The expected useful service life of building components is available from at least two sources. Appendix I has been taken from a facilities manual used in the Pennsylvania State System of Higher Education. It contains a list of numerous facility components and their service life under average circumstances. An alternate source is available through the R.S. Means Company's various publications.

The approximate percentage of a facility component that would be eligible for replacement or renewal requires definition and also requires an explanation of where this percentage data can be obtained. By way of definition, within any facility, there are components that will never be renewed because they are inaccessible for renewal purposes. For example, portions of electrical conduit or sanitary drainage systems may be completely encased in concrete flooring or buried deep in the building's foundation. In these cases, their inaccessibility makes them ineligible for renewal because to do so would entail virtual destruction of the facility.

Even visible components such as masonry are not likely to be replaced in their entirety. Instead, they will be renewed through a masonry restoration project wherein replacement of selected masonry units, cleaning of others, and refurbishing of mortar joints will be accomplished.

Judgement and consultation with the design architects and engineers are the best data sources for determining the approximate percentage of a particular building component that will require eventual replacement or renewal. The percentages can range from zero to one hundred percent.

On a facility-specific basis, the Schedule of Values will reveal some components that have a zero percentage of renewal or replacement. These items can be ignored from a life cycle costing standpoint. Entries on the Schedule of Values such as excavation, site preparation, installation of steel or grade beams all generally fall into this category.

Other items on the schedule of values such as heating, ventilating, and air conditioning (HVAC) components, electrical components, and finishing components such as millwork and casework will require and assessment of what percentage of the total installed value will eventually require replacement or renewal. However, a review of the plans, combined with consultations with the designers, will quickly establish these percentages.

Finally, many facility components will clearly require 100 percent replacement over time. Examples of components in this category are exhaust fans, windows, compressors for air conditioning systems, circuit breaker panels, most lighting components, etc. In general, the components that will require 100 percent replacement or renewal are usually very obvious after a cursory review of a facility's plans, specifications, and Schedule of Values.

Step 2: Organizing the Data

A useful tool for organizing the initial cost, service life, and percentage of renewal/replacement data for all building components is the computer spreadsheet. Software products such a Lotus, Appleworks, or other programs that contain spreadsheet capability can be used to post the component name and initial installation cost in the first two columns as shown in Appendix II. This information can be taken directly from the Schedule of Values. Then, referring back to Appendix I, the expected service life of the component can be determined and entered as a third column on the spreadsheet as indicated in Appendix II. After establishing these three data elements for each component, create a fourth column that indicates the percentage of the component which is eligible for replacement or renewal at the end of the that component's service life. Appendix II also contains this fourth column.

Step 3: Calculate Replacement or Renewal Costs

After establishing the expected useful service life, the initial cost for purchase and installation of a building component, and the percentage of a component eligible for replacement or renewal, it is then possible to determine the cost of renewing/replacing the component at the end of its life. The method used to accomplish this employs the compounding rate formula which will yield the inflation-adjusted renewal or replacement cost at the end of the component's service life. The formula is state as follows:

$$R = P(1-I)^N$$

where:

P =	the original cost for purchase and installation
i =	the annual inflation rate, i.e. 2% = .02, 3% = .03, etc.
N =	the component's expected useful service life in years.
R =	the inflation-adjusted replacement cost at the end of "N" years.

For example, referring the Appendix II, the first component listed is seven "Exhaust Fans Roof" with a total purchase and installation cost of $6,142.50. The expected service life is 15 years, and we can expect to replace 100 percent of this component by the end of that time. With the compounding rate formula, the following results can be obtained using an annual 3.5 percent inflation rate.

$$R = (\$6{,}142.50 \times 1.00) \times (1+.035)^{15}$$

$$= \$6{,}142.50 \times (1.035)^{15} = \$6{,}142.50 \times 1.68 = \$10{,}290.83$$

Thus, assuming a 3.5 percent annual inflation rate, it will cost $10,290.83 to replace the seven exhaust fans after 15 years of service. Note that $6142.50 is multiplied by 1.00 to indicate the anticipated replacement of 100 percent of the exhaust fans by the end of the fifteenth year.

Step 4: Convert Renewal or Replacement Cost to an Annual Cost

To accumulate $10,290.83 at the end of 15 years, there should be a fixed amount that is set aside annually for budgetary purposes. In setting aside this amount, we are calculating the magnitude of an annual payment to a fund, sometimes called a sinking fund, which at the end of 15 years will contain the amount of money needed to pay for renewal of the exhaust fan system. The sinking fund formula shown below is used to determine an annual payment to the fund.

$$A = R \times \frac{i}{(1=I)^{N} - 1}$$

where:

R =	the needed dollar amount to replace the component at the end of "N" years.
i =	the average annual interest rate that would be applied to an annual deposit of funds.
N =	the component's expected useful service life in years.
A =	the annual payment to a fund that will accumulate an amount of money, "R", at the end of "N" years.

Continuing with our example of the exhaust fans, the following annual payment can be determined using the above formula. For this example, the formula assumes that we would earn an average of 4 percent on the annual amount deposited in the fund.

$$A = \$10{,}290.83 \times \frac{.04}{(1 + .04)^{15} - 1}$$

$$= \$10{,}290.83 \times \frac{.04}{(1.800 - 1)} = \$10{,}290.83 \times .049 = \$513.90$$

The annual amount that must be set aside to accumulate $10,290.83 at the end of 15 years is $513.90. However, many institutions would not assume this annual deposit would earn 4 percent annual interest. Of course, if this is the case, the sinking fund formula need not be used. Instead, use the simpler procedures of dividing $10,290.83 by 15 years to obtain $686.05 which is the required annual deposit to replace the exhaust fans at the end of 15 years without interest application on the annual deposits. In either case, the annual deposit can be viewed as a budget requirement.

Costs of masonry, the second example in Appendix II, would be calculated in exactly the same way, except that the initial cost would be multiplied by .30 rather than the 1.0 used in the previous example for exhaust fans. The resulting adjusted initial cost for masonry would then reflect the anticipation of replacing/renewing only 30 percent of the initial cost for the masonry installation.

Applying Life Cycle Costing to Older Facilities

The previously described process can also be applied to older facilities, but the sources of the data discussed in Step 1 are different. Obviously, with an older facility, it is unlikely that the Schedule of Values would be available. Moreover, an older facility probably will have undergone a number of system changes and minor renovations to accommodate programmatic needs since its original construction. To obtain relatively current building component costs, useful service life of those components, and the approximate percentage of each component that is eligible for renewal in older facilities, the information contained in a current facilities audit is invaluable.

A facilities audit will provide square footage and condition information for structural building components such as wall, floor, and ceiling finishes. From the square footage and condition, a relatively accurate cost estimate can be developed for their replacement along with the service life remaining for the components. Similarly, the present cost and forecasted remaining service life for various electrical and mechanical systems in a facility can be determined. Programming for renewal of exterior components such as masonry walls or roofing can also be accomplished.

A facility's windows offer an example of the use of a facilities audit in the life cycle costing process for older buildings. Assume that the audit shows that there are 4,500 square feet of window space in a facility, and the windows are 15 years old. Further, the audit and inspection indicates a component condition that suggests another five to eight years of service from these units. Consultation with window manufacturers, substantiated through estimating manuals, indicates that a realistic replacement cost for windows in an institutional building is approximately $35.00 per square foot of window space. Thus, the present replacement cost for replacing the windows is $157,500 (4,500 x $35.00).

The present window replacement cost of $157,500, combined with the expected service life remaining of five to eight years, can be used as input data in the formulas explained for new construction previously. The output of the formulas shows that $34,536.45 should be set aside annually for replacing 100 percent of the windows in five years or $22,508.39 for replacement in eight years. Again, this annual amount is another budget requirement.

Annualized replacement/renewal costs for virtually all building components can be calculated using facilities audit data for older buildings. Essentially, square footage or systems data contained in the audit can be combined with typical square footage or systems costs to obtain a current replacement or renewal cost for a component. This figure, combined with the expected remaining service life, can be used to determine the annual amount that should be budgeted for eventually replacing a component of interest. However, the process carries a basic assumption that a viable preventive maintenance program is also consistently pursued.

Developing Annual Costs for Preventive Maintenance

Obviously, it would be difficult to attain the expected service life of a building component without normal preventive maintenance, at least to the extent of following manufacturers' recommendations for periodic servicing of facility components. The results of ignoring preventive maintenance are a briefer service life, premature replacement of the component, and increased utilities costs in the case of components that require energy resources. Consequently, knowledge of preventive maintenance cost data is important for two reasons. First, preventive maintenance constitutes a substantial portion of the facilities operating budget. Second, the cost trends provide an indication of equipment deterioration and expected remaining service life.

Gathering Data for Annual Preventive Maintenance Costs

Annual budget data for preventive maintenance costs can be obtained from work order history files and/or staff interviews that convey the amount of time spent on tasks related to various systems. This information, combined with current labor rates and material costs, will reveal the annual cost of maintaining components that require preventive maintenance.

Organizing the Data

Posting preventive maintenance task descriptions, task times, labor rate and materials costs, and frequency of service information on a spreadsheet will aid in determining the overall annual costs for servicing various facility components. Apart from life cycle costing applications, it may well be that organizing data in this manner can be instructive with regard to over-maintaining or under-maintaining components. However, once these concerns have been accommodated, annual costs associated with preventive maintenance tasks can be determined rather quickly by using spreadsheet cell formulas to manipulate the data.

Appendix III shows the results of placing preventive maintenance information on a spreadsheet. The result is the total annual cost for preventive maintenance efforts associated with the entire facility. Note that the total annual preventive maintenance cost is based on current labor rates rather than those that might be in effect five years hence.

To forecast preventive maintenance costs for future years, some knowledge of trends in labor rate increases is necessary. Union contracts and the impact of inflation should be considered as a minimum. A safe assumption is to consider increases equal to the Consumer Price Index or four percent per year, whichever is higher, for at least the next five years. This will allow forecasting on the basis of five future years and is usually sufficient for a budget planning horizon.

The projected annual preventive maintenance costs for each of the upcoming five years can be determined using the compounding rate formula explained earlier. For example, referring to Appendix III, the current total annual preventive maintenance cost for the facilities is $12,206.60

for the first year. The compounding rate formula provides the following information for the first future year.

R =P(1+i)N

$R = \$12,206.60 \times (1.04)^1 = \$12,206.60 \times 1.04 = \$12,694.86$

By changing the value of N to reflect two, three, four, or five years beyond the current year, annual preventive maintenance costs that are discounted for inflation can be calculated for each of the upcoming five years.

Note that, in contrast to the replacement/renewal costs discussed earlier, the sinking fund formula is not applied to preventive maintenance cost calculations. The replacement or renewal costs discussed earlier were *not* initially stated in annual payment terms. The sinking fund formula was used in these earlier cases to convert an inflation-adjusted lump sum needed at some future time to annual payments. However, preventive maintenance costs are *already stated* on an annual payment basis, and the sinking fund formula is not needed. Annual preventive maintenance costs only require adjustment using the compounding rate formula to account for inflationary trends in labor rates and material costs.

As in the case of preventive maintenance costs, a similar situation exists with custodial and utilities costs.

Data Sources and Calculations for Annual Custodial Costs

Annual custodial costs for a facility are relatively easy to gather. If custodial activities are accomplished by contract, the annual cost may have been bid on a facility-specific basis with provisions for annual increases based on the Consumer Price Index. Thus, the current cost may be available in the contract documents.

If custodial work is accomplished by in-house personnel, the current total annual custodial cost for any facility can be determined or at least accurately estimated. This can be done by reviewing the various custodial tasks performed, the number of people performing them, the amount of time expended, the labor rates involved, and the materials used.

In the absence of facility-specific data, it may be possible to use the institution's total annual amount expended for custodial labor, supplies and equipment to develop a cost per square foot. Application of this cost per square foot will yield an approximate annual cost for custodial services in any facility of interest. Simply multiply the facility's serviced square footage by the approximate cost per square foot.

Regardless of whether a facility's custodial function is accomplished by contract or in-house resources, the sum of the labor, materials, and equipment costs previously described will provide a current annual cost for custodial operations on a facility-specific basis. Five year planning horizon costs can be calculated using the compounding rate formula in the same manner described for preventive maintenance costs.

For example, assume custodial costs in a particular facility are accomplished by contract. The current cost of these services is $38,000, and the contract restricts annual increases to no more than four percent per year. Using the compounding rate formula, the expected annual cost in the fifth year is $46,232.81. Changing the value of N in the compounding rate formula to one, two, three or four years beyond the current year will provide the related annual costs to complete the planning horizon for five years beyond the current year.

Data Sources and Calculations for Annual Utilities Costs

The final cost element for operating a facility is for utilities. There are a number of ways to determine a facility's total utilities costs and to forecast future annual rate increases. Of course, if power, gas, water, and steam meters are available, consumption data and corresponding costs are immediately available. In most cases, however, consumption data is routinely gathered from a group of facilities served by a single meter.

Two options are available for determining utilities costs if multiple facilities are served by a single meter. First, a rough estimate of a specific facility's total energy consumption can be developed by using the total square footage of all of the facilities served by the meter and prorating the utilities cost derived from the meter among the facilities involved. However, in using this method, the estimate for any facility of interest in the group is likely to deviate from its actual consumption by a significant amount. Building characteristics such as insulation, fenestration, and system differences can cause faulty estimates. Unless all facilities served by a common meter are relatively similar in these respects, an alternate approach should be used.

A better approach is to request assistance from utilities companies in conducting audits of the facility group being served by a common meter. In accomplishing audits, costs can be developed on a per square foot basis that apply to particular functions in a facility. The utilities cost per square foot in a class room with and without windows, in laboratories, in rest rooms, in offices, etc. can be determined. Subsequently, it is relatively easy to apply this more specific cost information to any facility of interest and determine relatively accurate costs based on current rates for each utility. If some utilities companies cannot assist in an audit due to a lack of resources for this service, it is also possible to purchase the services of engineering firms that perform this work. Qualified in-house resources may also be available.

Projected annual utilities rate increases can be determined by reviewing historical data. When was the last rate increase and how much? How forthcoming are state utilities regulatory agencies in granting utilities rate increases? In general, a wealth of trend information is available. In Pennsylvania, utility rates for electricity, gas, and water have increased on the average of three to five percent per year for the past three years. There are indications through Utilities Commission filings that similar increases can be expected for the near term.

Once current utilities costs and expected rate increases are known for a facility of interest, the compounding rate formula can be used to establish annual utilities costs throughout a future five year planning horizon. The formula is employed in the same way that it was employed previously for future annual preventive maintenance and custodial costs.

As a typical illustration, assume that the present total annual utilities cost for a facility is $72,000. Annual rate increases of three to five percent are expected at least for the next three years. Increased facility use in the two to three year period after this time will probably cause utilities costs to continue this percentage increase through the end of the planning horizon. Therefore, a worst case scenario would suggest annual utilities cost increases of five percent per year for reasons attributable to rate or utilization, perhaps both.

Use of the compounding rate formula in this illustration will contain a rate of five percent (i=.05). In the first future year, the utilities cost will be $75,600. Applying the formula for the costs in the second future year will yield \$79,380 {\$72,000 x $(1+.05)^2$}. Expected annual costs for the third, fourth, and fifth future year can be calculated by simply changing the value of N.

Life Cycle Costing for Budgeting Purposes

A well-supported annual budget can be developed by summing the annual cost elements associated with each significant facility at an institution. For example, as one of many facilities that would be a part of the budget, Appendix IV shows the results of actual calculations to determine the total annual facility renewal, preventive maintenance, custodial services, and utilities costs for a new student center. Current costs were accumulated using the data sources described previously.

Note that the total current cost for the student center's renewal cost element is equal to future costs for this element. This is due to the use of the sinking fund formula which yielded annually equal payments that will be required to renew facility components at the appropriate times for as long as the facility remains operational.

Appendix IV also contains expected future annual costs for the other cost elements. They were developed for five future years using the compounding rate formula. If needed, all of the cost elements could be extended to include additional years, but forecasts for inflation rates and utilities rate increase may not be reliable beyond five future years.

The information in Appendix IV is important for several reasons. First, the summary cost elements and the more detailed cost information supporting those elements can assist in justifying a needed annual budget. Note that each cost is well-supported with sound estimating principles and mathematics that are used by virtually all financial institutions. In doing so, budget planning and justification move from a subjective arena of, "I need five percent more than I had last year because our facilities are aging" to a more rigorous argument. That argument incorporates specific budget information obtained through an objective analysis that is accomplished using sound mathematical principles and conservative, supportable estimates. In essence it is much more marketable to those who make funding allocations. This, combined with common sense and salesmanship, can be persuasive.

Second, in a climate of cost-cutting and restricted revenues, renovations must be forecasted to avoid uneven funding requirements from year to year. It is not advisable to pile three renovations into one year when operations and renovation costs could have been programmed and accomplished on a more favorable basis from the perspective of cash flow. Prospect for surge funding in the present climate are limited, and there is an excellent chance that an important project will not get funded in these circumstances. Life cycle costing can assist to preclude this situation because major renovations can be predicted, funded over a period of years, and scheduled successfully to minimize funding conflicts with other renovation projects and normal operations.

Third, how many times has departmental equipment been funded, purchased, and delivered only to discover that the power or ventilation requirements for the equipment were not available? The total cost picture reflected in Appendix IV for renewing and operating a facility, new or otherwise, is important in eliminating the potential for this expensive disconnect between facilities and other departmental budgets. If the life cycle costing information is shared and input is received from academic department heads, deans, student affairs directors, and other administrative officials, budgets for departmental equipment needs can be coordinated with facility infrastructure budget needs. Adjustments can be made to accommodate the mission of each department. At the same time, facilities budgets can support those equipment needs before funds have been spent, unscheduled alteration work disrupts an already demanding maintenance and repair schedule, and departmental equipment remains idle while altering a facility for its installation.

As a fourth and final reason, developing documents such as the one in Appendix IV for all significant facilities provides an ability to perform "what-if" analyses to examine the impact of various facility renewal and operations scenarios. For example, how will costs be influenced by replacing carpet in a facility on a ten year cycle rather than an eight year cycle? Can more emphasis be placed on HVAC preventive maintenance to extend the life of the systems by three to five years, and what is the cost impact of doing so? The answers to these questions will change the figures shown in Appendix IV. To organize and expedite the availability of those answers, the use of spreadsheet analysis is invaluable.

Spreadsheet Analysis

It was noted earlier that a useful tool for organizing the initial cost, service life, and percentage of renewal/replacement data for all building components is the computer spreadsheet. This is equally true for the annual preventive maintenance, custodial, and utilities operating cost data.

Appendices II and III are reproductions of spreadsheets that show *examples* of building components for renewal and preventive maintenance cost elements, respectively. Appendix IV is a spreadsheet that reflects costs that were developed on the basis of incorporating not only these examples but *all* renewal, preventive maintenance, custodial services, and utility costs. All spreadsheets were established using Lotus 123, Version 3.1.

Referring to these Appendices, assume that we are interested in evaluating the impact of changes in cost information. First, assume that the example of window service life in Appendix II can be increased by five years. Further, assume that we can reduce the frequency of several HVAC preventive maintenance tasks shown in Appendix III, resulting in a reduction of $2000 in the facility's overall annual preventive maintenance cost element. For additional changes, we anticipate future annual three percent labor cost increases for total facility preventive maintenance and custodial services rather than the four percent that was originally predicted in Appendix IV. Finally, again in Appendix IV, assume that the utilities commission did not approve the five percent rate increase that the utility company originally filed. Instead, the approved rate increase was reduced to 3.5 percent.

Appendix V is presented in the same format as Appendix IV and shows the cost impact of these changes. The ______ annual renewal and operating costs for the facility have been reduced by $3,212.23. Of course, cost projections for the facility in future years are also reduced. For example, in the fifth future year, they have been reduced by $12,719.03.

The important point regarding all of these changes is that the results of changing virtually any variable - expected service life, percentage of annual inflation, maintenance task frequencies, labor or utilities rates, etc. - can be explored and evaluated in only a few minutes if the data is posted on a spreadsheet. Any cost scenario a facility user chooses to explore can be displayed almost immediately. In all cases, the use of spreadsheets to explore life cycle and operating cost options can improve responsiveness in providing services and can facilitate accurate answers to cost estimate questions from the entire institutional community.

Summary

Life cycle costing involves four basic cost elements associated with almost any building: fa-

utilities costs. The costing process uses the compounding rate formula to provide an inflation-adjusted renewal or replacement

to covert the inflation-adjusted future payment for facility renewal to an annual budget cost.

Future annual costs for preventive maintenance, custodial services, and utilities are adjusted

materials for preventive maintenance and custodial services can be estimated using the Consumer Price Index or contractually defined annual percentage increases. To project annual utili-

increases, historical trends and/or utilities commission filings can be used.

An excellent method for evaluating the budgetary impact of cost changes is to employ the

able in spreadsheet software accommodate data manipulation and can greatly facilitate analysis of changes. These changes can be a consequence of altered circumstances or a consequence of

rate and timely information to facility users.

Conclusion

tual, objective foundation on which to base budget requests. Budgets that are prepared on this basis are likely to be more marketable than budget requests that are justified on the basis of thinly

common sense and salesmanship, will assist in obtaining the budget needed by those who are responsible for facilities renewal, maintenance, repair, and operations.

APPENDIX I

Suggested Average Useful Life of Facility Components

I. Major Construction - Primary Structure	
A. Foundation	50
B. Exterior Walls	
a. Reinforced Concrete Frame	
1. Masonry Exterior	
a. Heavy	45
b. Light & Medium	40
b. Steel Frame	
1. Masonry Exterior	
a. Heavy	45
b. Medium	35
c. Light	30
2. Metal Exterior	
a. Heavy	30
b. Medium	25
c. Light	20
c. Wood Frame	
1. Masonry Exterior	
a. Heavy	35
b. Medium	25
2. Metal Exterior	
a. Heavy	30
b. Medium	25
c. Light	20
3. Wood Exterior	
a. Heavy	25
b. Light & medium	20
C. Floors	
a. Wood	35
b. Concrete	45
c. Metal	40
D. Roof	
a. Structure	
1. Wood	35
2. Concrete	45
3. Metal	40
b. Covering	
1. Built up	25
2. Rubber	15
3. Elastomeric	10
4. Metal	20

APPENDIX I (con't)

Suggested Average Useful Life of Facility Components

II. Secondary Structure

A. Ceilings

1. Plaster	35
2. Gypsum board	35
3. Acoustic tile	15

B. Interior Partitions

1. Plaster	35
2. Gypsum Board	35
3. Wood	35
4. Masonry	45

C. Windows

1. Metal frame	15
2. Wood frame	15

D. Doors

1. Metal	15
2. Wood	15
3. Metal frame	15
4. Wood frame	15

III. Electrical and Mechanical Service Equipment

A. Electrical Systems

1. Lighting Systems

a. Conduit & Wire	20
b. Fixtures	15
c. Flood Lighting	15

2. Power Feed Wiring

a. Bus Duct	25
b. Capacitor	20
c. Power Feed Wiring Mains	25
d. Switchboards	20
e. Switch Units	20

3. Transformers

a. Wet Type	20
b. Dry Type	15

B. HVAC Systems

1. Air Conditioning Systems

a. Central, including ducts & piping	15
b. Window Type	10
c. Cooling Towers	15

2. Heating Systems

a. Furnaces & Boilers	20
b. Radiators, Convectors, Piping	25
c. Unit Heaters, gas & steam piping	20
d. Unit Heaters - Electrical	15

APPENDIX I (con't)

Suggested Average Useful Life of Facility Components

3. Ventilating Systems including fans & exhaust	15
C. Plumbing Systems	
1. Drinking Water System	15
2. Fixtures	20
3. Piping	
a. Cast Iron Waste	35
b. Concrete	30
c. Copper	30
d. Plastic	20
e. Steel	20
f. Vitrified Tile	30
4. Sprinkler Systems	
a. Wet & Dry Systems	30
b. Fire Pumps	20
1. Hose Housings	
a. Wood	15
b. Steel	20
c. Masonry	30
5. Sump Pumps	
a. Small	10
b. Large	15
6. Water Heaters - gas & electric	10
7. Water Wells	25
D. Service Systems	
1. Elevators (all types)	20
2. Fire Alarm	20
3. Intercom	15
4. Telephone	15
IV. Miscellaneous Items	
A. Bulkheads	
1. Concrete	30
2. Steel	25
3. Timber	20
B. Chimneys	
1. Brick or concrete	35
2. Steel-lined	25
3. Steel-unlined	20
C. Culverts	
1. Concrete	35
2. Galvanized Steel	20
D. Curbing	
1. Concrete	25

APPENDIX I (con't)

Suggested Average Useful Life of Facility Components

E.	Fencing	
	1. Brick or stone	30
	2. Chain Link	20
	3. Concrete	30
	4. Wire	10
	5. Wood	10
F.	Flag Poles	25
	1. Commercial type, steel fire brick lined	20
	2. Concrete block or brick	20
	3. Steel	15
H.	Paving and Walks	
	1. Asphalt on gravel or stone	15
	2. Brick	20
	3. Concrete	20
	4. Gravel, stone, cinders	10
	5. Parking area guard rails	10
I.	Platforms	
	1. Reinforced concrete	35
	2. Wood frame on concrete piers	20
	3. Wood frame on wood posts	15
J.	Railroad sidings	25
K.	Reservoirs, concrete	35
L.	Retaining Walls	
	1. Brick	30
	2. Concrete	40
	3. Steel	25
	4. Stone	40
	5. Wood	15
M.	Sheds	
	1. Brick, tile or concrete block with wood frame	25
	2. Brick, tile or concrete block with steel frame	35
	3. Metal clad, steel frame	27
	4. Metal clad, wood frame	20
	5. Wood siding and frame	20

APPENDIX II

FACILITY COMPONENT DESCRIPTION	#/KIND	TOTAL PRICE	EXPECT LIFE (YEARS)	PERCENT REPLACED	PROJECTED REPLACEMENT COST	ANNUAL COST
OBTAIN FROM SCHEDULE OF VALUES			OBTAIN FROM APPENDIX I	OBTAIN FROM A/E & PLANS	USE COMPOUNDING RATE FORMULA	USE SINKING FUND FORMULA
EXHAUST FANS ROOF	7	$6,142.50	15	100	$10,290.83	$513.90
MASONRY	1	$290,885.30	30	30	$244,936.51	$4,408.86
WINDOWS	45	$111,145.32	20	100	$221,155.72	$7,519.29

APPENDIX III

PREVENTIVE MAINTENANCE COSTS

EQUIPMENT ITEM	TASK DESCRIPTION	# OF UNITS	HR/PER UNIT	TIMES/ YEAR	COST/ HOUR	ANNUAL COST
A.H.U.	REPLACE FILTERS	14	0.75	4	$30.00	$1,260.00
	CLEAN	14	1.50	0.5	$30.00	$315.00
	LUBE	14	0.10	1	$30.00	$42.00
	ADJUST/RPL BELTS	14	0.50	2	$30.00	$420.00
FAN COIL UNITS	REPLACE FILTERS	28	0.75	4	$30.00	$2,520.00
	CLEAN	28	1.50	0.5	$30.00	$630.00
	LUBE	28	0.10	1	$30.00	$84.00
CHILLERS	WEEKLY CHECKS	1	0.50	54	$34.00	$918.00
	SPRING COMMISSION	1	15.00	1	$34.00	$510.00
	FALL DECOMMISSION	1	7.50	1	$34.00	$255.00
UNIVENTS	REPLACE FILTERS	19	0.25	4	$15.00	$285.00
	CLEAN	19	0.75	0.5	$30.00	$213.75
	LUBE	19	0.10	1	$15.00	$28.50
UNIT HEATERS	REPLACE FILTERS	14	0.25	4	$15.00	$210.00
	CLEAN	14	0.75	0.5	$30.00	$157.50
	LUBE	14	0.10	1	$15.00	$21.00
BASEBD RADS	CLEAN & ADJUST	9	0.75	0.5	$34.00	$114.75
HEAT EXCHNGRS	CLEAN	1	2.00	0.5	$34.00	$34.00
PUMPS	CLEAN	4	0.25	2	$17.00	$34.00
	ALIGN	4	0.25	2	$17.00	$34.00
	CHECK BRNGS/PCKG	4	0.25	2	$17.00	$34.00
	LUBE	4	0.10	1	$17.00	$6.80
EXHAUST FANS	LUBE	10	0.25	1	$17.00	$42.50
	CLEAN	10	0.25	1	$17.00	$42.50
STEAM TRAPS	ADJUST & CLEAN	20	0.50	1	$17.00	$170.00
ATC CNTRLS	ADJUST & CLEAN	127	0.25	2	$21.00	$1,341.50
AIR CMPRSR	LUBE	1	0.10	2	$17.00	$3.40
	CLEAN	1	1.00	2	$17.00	$34.00
	CHECK	1	0.10	12	$17.00	$20.40
EMER GNRTR	OPERATIONAL CHK	1	0.50	12	$17.00	$102.00
FIRE ALARMS	OPERATIONAL CHK	15	0.10	4	$40.00	$240.00
FIRE EXTING	CHK/RECARGE	15	0.50	2	$18.00	$270.00
	SPRINKLER INSPECT	1	4.00	1	$120.00	$480.00
KITCHEN EQUIP	HOODS CHECK	3	0.25	2	$32.00	$48.00
	OVENS, P.M. CHK	1	1.50	4	$15.00	$90.00
	FRYERS, PM. CHK	3	0.50	4	$15.00	$90.00
	REFER EQPMNT CHK	4	0.25	52	$17.00	$884.00
ELEVATOR INSP		1	0.25	52	$17.00	$221.00
TOTAL	**PREVENTIVE**	**MAINT**				**$12,206.60**

APPENDIX IV

SUMMARY OF ANNUAL FACILITY COSTS
GEMMELL STUDENT COMPLEX

COST ELEMENT DESCRIPTION	FY 93-94 CURRENT COST	FY 94-95 ANNUAL COST	FY 95-96 ANNUAL COST	FY 96-97 ANNUAL COST	FY 97-98 ANNUAL COST	FY 98-99 ANNUAL COST
FACILITY RENEWAL COSTS	$119,241.24	$119,241.24	$119,241.24	$119,241.24	$119,241.24	$119,241.24
PREVENTIVE MAINTENANCE	$12,206.60	$12,694.86	$13,202.66	$13,730.76	$14,280.00	$14,779.80
CUSTODIAL CONTRACT	$38,000.00	$39,520.00	$41,100.80	$42,744.83	$44,454.63	$46,232.81
UTILITIES	$72,000.00	$75,600.00	$79,380.00	$83,349.00	$87,516.45	$91,892.27
TOTAL ANNUAL COSTS	**$241,447.84**	**$247,056.10**	**$252,924.70**	**$259,065.84**	**$265,492.31**	**$272,146.12**

APPENDIX V

SUMMARY OF ANNUAL FACILITY COSTS
GEMMELL STUDENT COMPLEX

COST ELEMENT DESCRIPTION	FY 93-94 CURRENT COST	FY 94-95 ANNUAL COST	FY 95-96 ANNUAL COST	FY 96-97 ANNUAL COST	FY 97-98 ANNUAL COST	FY 98-99 ANNUAL COST
FACILITY RENEWAL COSTS	$118,029.01	$118,029.01	$118,029.01	$118,029.01	$118,029.01	$118,029.01
PREVENTIVE MAINTENANCE	$10,206.60	$10,512.80	$10,828.18	$11,153.03	$11,487.62	$11,832.25
CUSTODIAL CONTRACT	$38,000.00	$39,140.00	$40,314.20	$41,523.63	$42,769.33	$44,052.41
UTILITIES	$72,000.00	$74,520.00	$77,128.20	$79,827.69	$82,621.66	$85,513.41
TOTAL ANNUAL COSTS	**$238,235.61**	**$242,201.81**	**$246,299.59**	**$250,533.35**	**$254,907.62**	**$259,427.09**