LIFE CYCLE COST ANALYSIS ON THE FLY

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ABSTRACT

Due to the time consuming nature of life cycle costing (LCC), VE often can pay only token attention to this important tool. This presentation offers a method to quickly assess the LCC implications of various component alternatives. This presentation offers a method to quickly asses the LCC implications of various component alternatives. This method uses a computer spreadsheet requiring minimal data entry and manipulation. Results are positive, and provide quantified comparative LCC information to the study team and the owner.

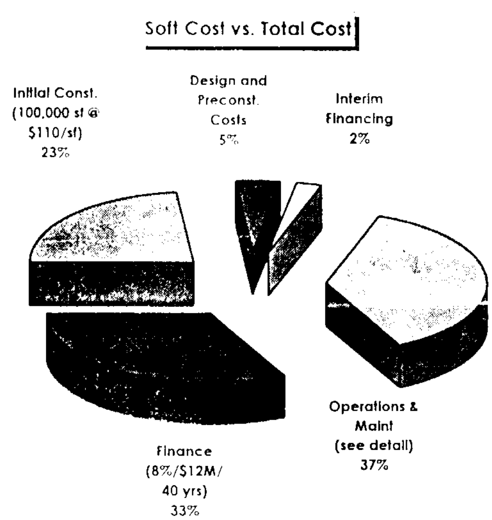
COMPLEX LIFE CYCLE COSTING

LCC has long been recognized as an important tool for analyzing VE alternatives. For construction, there are several excellent computer analysis programs which present a relatively sophisticated economic assessment of all significant ownership costs over the life of a building. Most of these models focus on energy and fuel costs, but some are more comprehensive, considering also maintenance, repair, replacement, utilities, equipment, and even staffing.

LIFE CYCLE COSTING IN VE

After the Arab oil embargo crisis in 1973, the Energy Policy and Conservation Act encouraged the development of many comprehensive energy LCC analysis programs for public facilities. Washington State led the way with its mandatory program, and has since developed a 20 year database derived from thousands of detailed computer-based analyses. At one point, the State even attempted to mandate better coordination between project LCC analysis and the separately required VE studies, but this has been difficult due to the cumbersome time and cost for the LCC studies. For example, using a TRACE program, a typical 200,000 S.F. high school analysis can easily require 120 hours under the Washington State guidelines. The computer run alone, consumes 20 to 30 hours and occupies 20 to 25 megabytes. This program focuses on energy performance and carefully considers building orientation, glazing, occupancy schedules, and zoning. Other mainstream analysis programs include:

- The National Institute of Standards and Technology (NIST) Building Life Cycle Cost Program:
  2 to 5 megabytes for each component alternative.
- Department of Energy (DOE) Analysis and modeling program:
  30 to 40 megabytes for a complete building analysis.



While these programs attempt to predict fairly accurately long term life cycle costs, that is typically not the goal in a VE study. Rather the VE team needs a method to very quickly assess which specific component alternatives, if any, have important LCC impact; and then to make an order-of-magnitude comparison between the alternatives. The major preferred alternatives can then be analyzed in a more comprehensive program as outlined above.

SPREADSHEET TEMPLATE

The spreadsheet template presented herein is organized around the Uniformat II breakdown: a function-based format commonly used by VE teams for cost modeling. All Uniformat categories are included to model and demonstrate that some components have insignificant life-cycle cost impact on the entire facility.

On the spreadsheet, the component construction unit costs and quantities for the current design are entered directly from the project cost estimate. An appropriate discount rate and study period are also entered. The spreadsheet is formatted to calculate and enter the present worth annuity automatically from a linked table, but sensitivity analysis shows that a constant dollar approach may be sufficient for simple comparative analysis.

LIFE CYCLE COST DATABASE

The most important element in any LCC analysis is the reliability of the LCC cost information. Unfortunately, there are few if any industry-wide databases that uniformly apply to any project. Starting with a database that is most appropriate for the area in which the VE practitioner normally works, one typically has to build over time ones own database.

This example used data from "Maintenance & Replacement Estimating Data," compiled by Stephen Kirk and Alphonse Dell'Isola; from "Income and Expense Analysis for Office Buildings," published by the Institute of Real Estate Management ; and from the "Building Component Spreadsheet" compiled by ASTM. For energy costs, the Washington State Energy Office database figures were summarized and extrapolated for specific HVAC systems.

The resultant database was organized on a single Excel spreadsheet for direct line item copy into the separate project template summary sheet.
(Figure 2) In this manner, specific alternates can be selected and compared not only against each other, but also in relation to total building first cost and life cycle cost performance.

Where the impact is significant, and this becomes a major "selling point" for an alternative, a more comprehensive traditional LCC analysis can be completed. These might typically include a detailed lighting fixture manufacturer's LCC analysis for a specific fixture, (such as Lighttolier) or a NIST computerized detail component analysis.

CONCLUSION

The inevitable questions at the concluding VE study presentation are: "did the VE team consider that the alternative will cost us more to maintain and repair?" or alternatively, "If we spend more now, will it ever payback in reduced maintenance?" With the Project LCC analysis summary spreadsheet as backup, the VE team can provide a positive answer. A direct quantified comparison can be made either against the current design approach or against the total ownership costs. The answer may not contain a 200 page computer printout, but it will be a tool the owner can use to make an appropriate choice.

LCC COMPONENT WRKSHT

LIFE CYCLE COST ANALYSIS -- COMPONENT TEMPLATE

DISCOUNT RATE, %	5%	3.321942375
STUDY PERIOD, YEARS	30	0.216097119
PRESENT WORTH ANNUITY	15.37	
BLDG. GROSS SF	179,300	

LEFT SIDE OF SPREADSHEET

UNIFORMAT LEVEL II	UNIFORMAT DESCRIPTION III ALT. #	UNIFORMAT DESCRIPTION IV	PRODUCT	UNITS QTY PER BUILDING	UNIT TYPE	FIRST COST UNIT PRICE	FIRST COST TOTAL	MAINTENANCE UNIT COST PER YEAR
B20	EXTERIOR CLOSURE							
	0.001	Exterior Walls	Split Faced CMU Veneer	65,867	WSF	6.75	$444,602	0.09
	0.004	Exterior Walls	EIFS	65,867	WSF	6.50	$428,136	0.34

RIGHT SIDE OF SPREADSHEAD, CONT.

TOTAL MAINTENANCE COST PER YEAR	TOTAL MAINTENANCE COST PER YEAR; PER GSF	REPLACEMENT PERIOD IN YEARS	REPLACEMENT PERCENTAGE	REPLACEMENT COST EXPRESSED PER YEAR	SUBTOTAL-- MAINTENANCE & REPLACEMENT COST PER UNIT	SUBTOTAL-- PRESENT WORTH	SUBTOTAL-- PRESENT WORTH PER GSF	INITIAL COST PER BLDG GROSS SF	TOTAL LCC (INITIAL + O&M) IN PRESENT WORTH $
5,928	0.0331	100	100%	$ -	5,928	91,128	0.5082	2.48	535,731
22,395	0.1249	20	33%	$ 7,064	29,459	452,857	2.5257	2.39	880,993

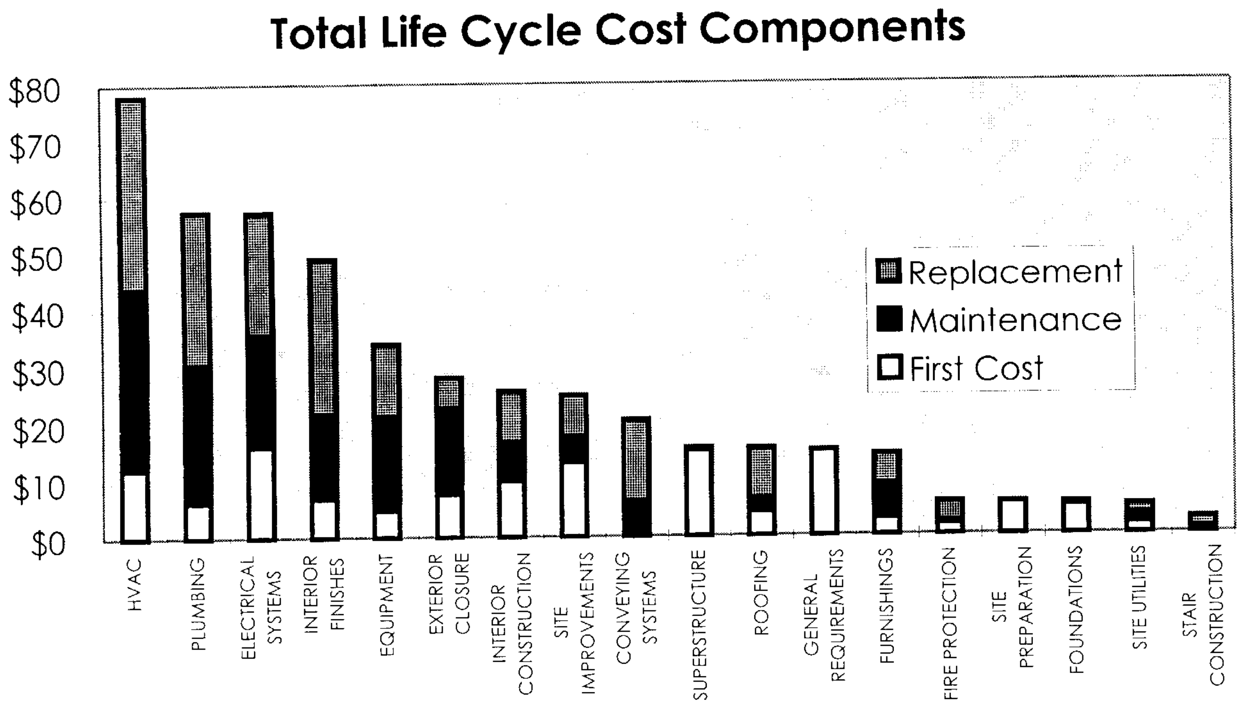
[box] indicates manual data entry. All others calculated automatically

FIGURE 2 - SPREADSHEET TEMPLATE MINIMAL DATA ENTRY

ITEM #	SYSTEM CATEGORY	SYSTEM DESCRIPTION	unit	ANNUAL MAINTENANCE COST	REPLCMNT. INTERVAL	REPLCMNT COST
B3010-001	ROOF COVERINGS	BUILTUP ROOFING	SF	0.15	28	2.06
B3010-002	ROOF COVERINGS	CEMENT ASBESTOS	SF	0.1	70	2.24
C3010-014	MASONRY AND TILE	CONCRETE BRICK	SF	0.02	500	26.12
C3010-015	MASONRY AND TILE	FIRE BRICK	SF	0.02	500	25.46
B3010-002	ROOF COVERINGS	CEMENT ASBESTOS	SF	0.1	70	2.24

FIGURE 3 - AUTOMATED ENTRY SHEET

FIGURE 4


Total Life Cycle Cost Components
$80
$70
$60
$50
$40
$30
$20
$10
$0
Replacement
Maintenance
First Cost
HVAC
PLUMBING
ELECTRICAL SYSTEMS
INTERIOR FINISHES
EQUIPMENT
EXTERIOR CLOSURE
INTERIOR CONSTRUCTION
SITE IMPROVEMENTS
CONVEYING SYSTEMS
SUPERSTRUCTURE
ROOFING
GENERAL REQUIREMENTS
FURNISHINGS
FIRE PROTECTION
SITE PREPARATION
FOUNDATIONS
SITE UTILITIES
STAIR CONSTRUCTION