

ESTIMATING FOR VALUE ENGINEERING

Gino V. Colacchia, CPE, CVS



Gino Colacchia is a project manager with O'Brien-Kreitzberg Associates. His responsibilities include management of regional estimating and VE services.

Gino received his Mechanical Engineering degree from Los Angeles Technical College. During his 28 year career he worked for 3 of the nation's largest design build mechanical contractors. His experience includes the construction of over 100 commercial buildings, exceeding 27 million square feet.

Gino serves on chapter boards of the American Society of Professional Estimators, and SAVE. He served as chapter president of the American Society of Heating, Refrigeration, and Air Conditioning Engineers. Gino is a Certified Professional Estimator.

ABSTRACT

Accurate cost estimates are essential for the acceptance and implementation of VE proposals. A presentation will be made of estimating concepts, techniques, cost modeling, estimating methodologies and life cycle costs. Application of the VE Job Plan to an estimating methodology will be made. This methodology can be applied to producing project cost estimates or VE estimates. The lecture will be focused on commercial building projects. The objective is to draw attention to the importance of the cost estimate as one of the driving factors required to establish successful VE proposals.

INTRODUCTION

The fundamental purpose of providing VE services is to give the client the greatest value for every dollar invested. To establish the investment, every function should be evaluated using a cost worth analysis. One of the key ingredients in the equation is the accuracy of the VE estimated costs. The intent of this paper is to assist the VE team in fully utilizing this ingredient. The estimate should be prepared in such a way that it can be easily digested, using component parts that were derived from the original base line project estimate.

VE practitioners who utilize their skills on commercial buildings can be more effective if they understand how estimates are prepared and how to employ the base line estimate to develop VE proposals. The author has experienced many

workshops that were highly successful in providing the client with valuable VE proposals. The majority of them had extensive base line cost estimates for the original scope of work. It is important to encourage clients to provide the VE team with a professionally prepared estimate of the scope of work under study. It is my opinion that the time spent at the VE workshops is less effective if the original estimate lacks sufficient detail.

One can analyze and develop great proposal ideas during the VE workshop, but they will not be seriously considered for implementation unless they prove to be cost-effective. The team can achieve a greater degree of success if the VE proposals are accurately estimated and include life cycle cost studies where applicable.

ESTIMATING CONCEPTS AND TECHNIQUES

Estimating is an art not a science. When applying sound principles, the results can be viewed from an historical perspective. Estimating is creating a cost picture using the snap shots from millions of historic scenes. One must be able to see the picture before it can be developed. This concept is simple and can be an effective way to produce accurate estimates for the VE workshop.

VE results are driven by the goal of reducing costs while improving or maintaining function and quality. The ability to accurately estimate the net savings between the original design and the VE proposal is essential to achieving that goal.

Estimating is the process of predicting or

forecasting accurate costs using known actual costs; information about the work product being developed; and a judgement based on experience, research, and historical data. In fact, there is no such thing as a truly precise or accurate cost estimate, only a reasonable one.

The VE job plan can be applied to an estimating methodology.

I INFORMATIONAL PHASE

- Review the project data
- Define the scope of work
- Evaluate building functions

II SPECULATION PHASE

- Quantify building elements
- Establish estimate formats
- Generate estimate assumption

III ANALYSIS PHASE

- Analyze method of takeoff
- Organize estimates required
- Select units of measurement

IV DEVELOPEMENT PHASE

- Create quantity takeoff
- Price unit cost items
- Summarize estimated items

V PRESENTATION PHASE

- Review estimated costs
- Document estimate assumptions
- Submit estimate of costs

The typical approach used by many professional estimators is to first quantify units of measure and then establish a cost for each unit type. Estimating manuals have been written for nearly every conceivable unit of measure in commercial building. There are costs per linear foot, square foot, square yard, cubic foot, gallon, ton, pound, diameter inch, and other special units.

The estimator must know the industry's use of these units to properly use them in the estimate. These same units can be used in the unit cost approach to estimating. The difference is knowing how to combine the units together to make an assembled unit cost.

Most estimators utilize functional assemblies as a technique for estimating component parts of systems. The industry does not publish an extensive database for functional assemblies. An estimator can, however, establish a unit cost estimate using current published data by recognizing which component parts can be used to make up an assembly. The result will

be an approach that can be used to quickly estimate from completed or conceptual plans.

Having a base line estimate to work with is important. For example, assume a base line estimate lists the cost of installing a six-inch thick reinforced concrete sidewalk:

Clearing and Grubbing	\$.10/sf
Grading	.10/sf
Concrete Forming	1.00/sf
Reinforcing Steel	.60/sf
Pour Six Inches of Concrete	1.90/sf
Finish Concrete Surface	.50/sf
Total Assembly Unit Cost	4.20/sf

From the base line estimate we can establish the cost for a six-inch concrete sidewalk by excerpting from the estimate the square-foot-unit costs of each component part. We have now established an assembly unit cost of \$4.20/sf. We will then use this assembly in our VE proposal.

The proposal under study involves reducing the cost of the sidewalks while maintaining quality and function. During the informational phase it is noted that the project has 50,000 square feet of sidewalk.

These modifications are recommended: delete the reinforcing steel, use a fiber-reinforced concrete mix to strengthen the sidewalk, and reduce the concrete thickness from six inches to four.

Checking with the architect on the proposed function of the sidewalk and confirming that no vehicle traffic can cross the sidewalks, the goal of VE is achieved: costs are reduced, while quality and function are maintained. The assembly cost model has allowed the quick determination of savings.

Using the \$4.20/sf and subtracting the \$.60/sf for the reinforcing steel and the \$1.90 for six-inch concrete, we get \$1.70/sf. We can now add the new cost of the fiber-reinforced concrete mix -- \$.24/sf, and the cost of four inches of concrete -- \$1.27/sf, to the \$1.70/sf. This establishes the VE proposal approach to be \$3.21/sf. We can now establish the amount of sidewalk savings that can be realized from the original project design to the proposed VE proposal.

The proposal would show the cost of the original design versus the proposed VE alternate. The savings can be established quite easily using this technique of estimating:

EQUATION:

$\$4.20 - \$0.60 + \$1.90 = \$1.70/\text{sf}$, w/o concrete & steel rebar
 $\$1.70 + \$0.24 + \$1.27 = \$3.31/\text{sf}$, w/ 4" concrete & Fiber fill

Base Line Estimate:

$50,000 \text{ sf} \times \$4.20 = \$210,000$

VE Proposal:

$50,000 \text{ sf} \times \$3.21 = \$160,000$

VE Proposed Savings = \$49,500

Although this example is simplistic, it illustrates the use of an assembly unit cost derived from the base line estimate to quickly develop a VE proposal.

The typical VE workshop lasts only three to five days. This tight schedule makes the estimating efforts important in the success of accurate VE proposals since time is a limiting factor. The estimator cannot begin the estimate until the proposal moves from the informational phase to the development phase. Since time is a vital factor at that point, having a professional estimator as a part of the VE team may be necessary on large, commercial-type projects that encompass a variety of building components and systems being evaluated for VE proposals.

An accurate base line estimate is essential to the VE workshop. The estimate should be presented in a standard estimate format, such as the Construction Specification Institute (CSI) divisions 1 through 16 and appropriate subsections, and that uses unit prices and assembly units. This will allow the VE team members to quickly and easily see the areas of cost for the items under VE consideration.

The VE proposals should be based on the same units of cost as the original estimate for the project. This gives the project design team the advantage of knowing that the VE proposals are consistent in cost units with the base line estimate.

Presenting VE proposals that are based on independent estimates is acceptable when the base line estimate does not afford usable units of costs. When this method is used, the estimator should use the same units of cost for the present design concept as the VE alternate proposal. In either case the estimate should be conservative with respect to cost and quantities.

COST MODELING FOR VE

Cost modeling is a technique that should be used

in VE efforts. This technique is used by the practitioner to quickly identify areas of abnormally high costs within the project. These areas can then be targeted for potential costs savings.

Cost modeling begins with segregating the estimate into different categories of work. A typical commercial building is estimated into the standard categories of work in accordance with the CSI master format. Within each division the estimator further makes a breakdown of subsections of work. The costs of all the items that make up the detailed subsections of work become the division total. The CSI divisions 1 through 16 are:

- Division 1: General Requirements
- Division 2: Sitework
- Division 3: Concrete
- Division 4: Masonry
- Division 5: Metals
- Division 6: Wood and Plastics
- Division 7: Thermal and Moisture Protection
- Division 8: Openings (Windows and Doors)
- Division 9: Finishes
- Division 10: Specialties
- Division 11: Equipment
- Division 12: Furnishings
- Division 13: Special Construction
- Division 14: Conveying Systems
- Division 15: Mechanical
- Division 16: Electrical

It is essential to have an estimate of all costs broken down into divisions of work for the base line estimate. This estimate becomes the working tool for the VE team members.

From this base line estimate, the VE team leader will develop a cost model for the project.

The cost model is typically presented in three categories of units of measure: dollars, dollars/sq.ft., and percent of total project cost. Cost models are normally shown as a series of blocks to help the VE practitioner recognize and visualize the relationship of the cost elements for each division of work.

Each block will list: the original base line cost of the division, the dollar value of that item shown in dollars per square foot, and the percent of cost that the division represents with respect to the total cost of the project. The cost model can be expanded to as many levels of categories as necessary to show the cost impact of key elements of work. It is therefore crucial to have a well-developed base line estimate from which to work.

A cost model shows a diagrammatic presentation

of the cost of a system, work items, and key elements of the project. It will increase the practitioners' awareness of the cost elements as well as aid in identifying elements of high costs. These high-cost elements can then be studied for alternate solutions, giving the project the highest value for the required function at the lowest cost. Bar and pie charts can also be used to express the relative values between different elements of work.

Once the base cost model is established, the VE team can institute a targeted savings that can be applied to each element identified in the cost model. This is an effective method to assist the team in quickly focusing on the big picture. The following example defines a single cost item element that would be a part of a typical cost model:

<u>BASE LINE</u>	<u>TARGETED-10%</u>
DIVISION 15	DIVISION 15
MECHANICAL	MECHANICAL
\$75,000	\$67,500
\$12/Sq ft	\$10.80/sq/ ft
20%	18%

COST ESTIMATING METHODOLOGY

When preparing cost estimates for commercial facilities, the estimator should initially develop a work breakdown structure (WBS), using the CSI master format, that will be used to present all costs for the project. Material and equipment quantities are developed from plans, drawings, and specifications furnished by the design team.

Prior to the fully developed plans the estimator will establish unit costs from concept plans, schematic plans or partially developed plans using estimating formulas to establish the proper quantities and units of measure. Unit costs, or assembly costs, are applied to the quantities that have been developed.

Historical costs for a given geographic area need to be adjusted to the specific projects. Generally, this approach will establish reliable cost figures. For major equipment and specialty items, vendor quotes should be obtained.

Labor rates, including direct rates, fringes, and benefits for each of the civil, architectural, structural, mechanical, and electrical disciplines need to be developed. Crew rates should be developed based on craft rates, production rates, and construction rental equipment costs.

All estimating work can be computerized on an electronic spread sheet using a personal computer.

The estimating team needs to work with the CSI master format and develop common work breakdown structures that are standard to the construction industry. The American Society of Professional Estimators (ASPE) provides an estimating guideline that will be helpful in understanding the standards of the industry.

Development of an in-house database of commonly used unit costs will be useful in reducing the time requirements to research common unit costs. However, there are commercially available computerized estimating software systems that have standard cost databases with averaged unit costs that can be adjusted to the designated city and state. These systems can also be customized by adding your in-house database of unit costs. The construction industry offers an "on the shelf" database for every trade of construction, including architectural, structural, civil, mechanical, and electrical. These resources are invaluable to the professional estimator. Estimating for VE can be made even more effective with the proper use of these and other estimating tools that are currently available.

Each estimate is unique to the project for which it is being developed. Although there may be some similarities, in fact, no two buildings are the same. There are medical facilities that require many specialties, government buildings that must meet aesthetic and functional requirements, recreational facilities, office buildings, geographic locations, seismic requirements, to mention only a few of the considerations. With this in mind, one should approach the estimate using well-thought-out unit costs that are common for a specific item, and adjust them to the project conditions.

Using a unit cost of \$27 dollars per linear foot to install a four-inch copper water line ten feet above the floor would not be the same as installing the line twenty feet above the floor. Neither would the cost be double. The estimator must take the standard unit cost and factor it to account for the additional height. The factor can be based on the estimator's past experiences or referenced from other industry resources.

LIFE-CYCLE COST ANALYSIS

Life-cycle costing is an evaluation technique that considers the economic and non-economic aspects of a facility or building element over its entire life. The economic measures consider the full cost of ownership -- design, procurement, construction, operation, salvage and financing -- and are expressed in terms of equivalent dollars. The equalization of dollar cost is achieved through

present value techniques that consider the time value of money. Life cycle cost analysis is the key to objectively calculating true economic costs.

Non-economic factors such as safety, aesthetic, environmental and political concerns must also be realized and subjectively weighed. Simultaneous consideration of economic and non-economic factors leads to reasonable decision-making, which is the essence of life-cycle cost analysis.

Present value techniques are essential to measuring the true economic costs for dollar expenditures that occur in different time frames. A classic value analysis tradeoff in a building system is efficient operation versus initial capital cost. Present value techniques allow equal treatment of the initial and operating costs over the expected life of a system.

The techniques require several crucial pieces of information. The first is the time period, or life, to be used in making calculations. The second is the interest rate or time-value of money. An additional factor that may need to be considered includes escalation rates for operational costs, which may differ from the time-value of money.

Determination of these factors may be very challenging, but taking a common-sense approach will be the best guide to resolving the issues. Expected life cycles can be obtained from vendors, suppliers and operators of similar systems. Basic building structural elements can be estimated using standard tables. Determining time-value is a function of the funding source, either bond, private borrowing, or some other form of interest measure. Escalation factors are typically estimated using trend information from the past, current operating agreements or general economic forecasts adjusted for the relevant sector of interest.

The wise owner who knows the difference between lower first costs and lower operating costs will always challenge the question, "What is the Life-Cycle Cost?" The cost of constructing a commercial building is the least expensive when

compared to the cost of operating and maintaining the building over a long time. Therefore, life-cycle cost analysis plays an important role in preparing quality VE proposals.

SUMMARY

Estimating is an art not a science, and the estimator is the artist. Estimating requires professional judgement and experience. Estimators must envision what they are estimating and adjust their view to fit the actual project's requirements. The techniques of cost modeling, unit cost pricing and assembly units, and life-cycle cost analysis described in this paper combine well with the fundamental goals of VE. When utilized together with professional judgement and vision, they achieve the ultimate goal: giving the client the greatest value for every dollar invested.

REFERENCES

- Collier, Keith, *Estimating Construction Costs, A Conceptual Approach*, Virginia, Reston Publishing Company: 1984.
- Mudge, Arthur E., *VE, A Systematic Approach*, Joy Manufacturing Company: 1985.
- Means Building Construction Cost Data*, Massachusetts, Construction Publishers: 1993.
- VE Theory*, Instructor Guide, The Value Foundation, Washington, D.C.: 1984.
- Guidelines, Reference Material for VE Studies*, Texas, VEI, Incorporated, : 1991.
- O'Brien, J. James, *Preconstruction Estimating: Budget Through Bid*, McGraw-Hill, Inc.: 1944