VALUE ENGINEERING FOR THE PROCESS INDUSTRY

This document was presented at the 1993 International Conference of the Society of American Value Engineers (SAVE) at Fort Lauderdale, Florida. by Alphonse J. Dell'Isola, PE, CVS, Fellow, SAVE. It was published in the SAVE Annual Proceedings and is copyrighted (SAVE, 1993). Permission to upload this document to CompuServe has been given by SAVE.

Mr. Dell'Isola has been working full time in VE since 1963. He has conducted over 1000 Contract Management/VE services contracts on projects valued at over $25 billion that produced implemented savings of over $500,000,000. He conducted workshops, seminars and briefings to over 15,000 professionals. *Engineering News-Record* cited him in 1964 for outstanding achievement in VE. In 1968, he received the Distinguished Service Award from SAVE. In 1980, he received a Presidential Citation from the Society of Japanese Value Engineers. He testified as an expert VE witness before several House and Senate Committees. He is the author of *Value Engineering in the Construction Industry* and co-author of *Life Cycle Costing for Design Professionals, Life Cycle Cost Data and Project Budgeting for Buildings.*

ABSTRACT

The paper outlines the potential of VE application to the process industry. It describes the difference of applying the VE techniques to the process area versus hardware/building. It cites recent case studies of an oxygen generation facility and a large offshore oil/gas platform and discusses potential fees and results. Recommendations for initiating VE programs are given, followed by an illustration on how to integrate VE into the design process.

All value methodologies are basically alike -they optimize value by identifying areas of poor value and by systematically developing alternatives that perform the required functions at improved value. For process type facilities a subtle but very important difference from most programs is noted. That is, a comprehensive program that covers the entire spectrum of project evolution is a significant requirement. To do this, the value engineering (VE) effort should be performed concurrently with the design effort starting at the conceptual phase. In addition, a balanced approach should be utilized, making use of such techniques as design to cost, life cycle costing (LCC), energy studies and others to aid in across-the-board management of value. As a result, the owner/user is assured of a facility produced for the optimum capital outlay consistent with necessary values.

FACTORS TO BE CONSIDERED

During a VE effort a number of factors are involved:

A principal factor is the "Total Cost Concept". Total cost is the ultimate cost to design, construct, operate, maintain, replace and produce a facility or system for a specified period.

<u>The emphasis on first or initial cost, without proper regard for the other elements of total cost, is probably the greatest shortcoming in the convent-ional method of programming, planning and design of a project.</u>

A second factor is the location and status of the decision makers who have the most influence over the total cost of a project.

The smallest cost area in the LCC of a facility is expended in design - yet the decisions made during design, shaped by user input, have the greatest impact on total costs. Therefore, the highest return on investment can be expected when resources are allocated for value studies early in the design, focusing on the designer and user inputs.

The final factor, time of application, is actually another way of emphasizing the importance of early studies. It is a fact that by far the greatest potential for savings exists during early design. When VE first entered the process field in the sixties, studies were limited to the later phases of project development . The results were good; but thepotential savings were even greater. However, the carryover of value methodology from its industrial birthplace was not yet comprehensive enough to tackle the full spectrum of project evolution. Now, with the development of special techniques and the shedding of hardware-oriented thinking, value methodology can exploit the concept/development/design stage of project evolution where optimum cost reduction potential exists.

THE CONVENTIONAL APPROACH

Presently, the concept design of a facility is developed by process and design professionals to conform to the criteria of the owner-user. Subsequently, plans and specifications are generated on this basis by each design discipline involved. These documents usually become a compromise between design organizations standards and beliefs and those of the owner/user.

What stands out is the lack of a formal quality control/value assurance programs over decision making involved in the design and construction of major capital programs. This is surprising in view of the extensive QA/VA program being used for actual production of most industrial products, e.g., automotive, aircraft, computers, etc.

VE - A FRESH APPROACH

Existing practices may appear to be satisfactory, but continual input is required to keep systems and procedures at a level that optimizes their cost impact on a facility. The VE approach is an organized methodology directed toward achieving this goal. It ensures that the essential function of the facility is provided at the lowest overall cost.

VE differs from the conventional approach in that a formal job plan is used with a multi-discipline team of individuals who work together to channel their talents and experience in a way to make meaningful changes happen on purpose rather than by accident.

The job plan is modeled after the scientific approach to problem solving. Basically, it is a forcing technique to get people to think in a planned, organized fashion.

This approach can fill the gap presently realized in the conventional approach of a quality control/value assurance overview of major design decisions.

VE-APPLICATION TECHNIQUES

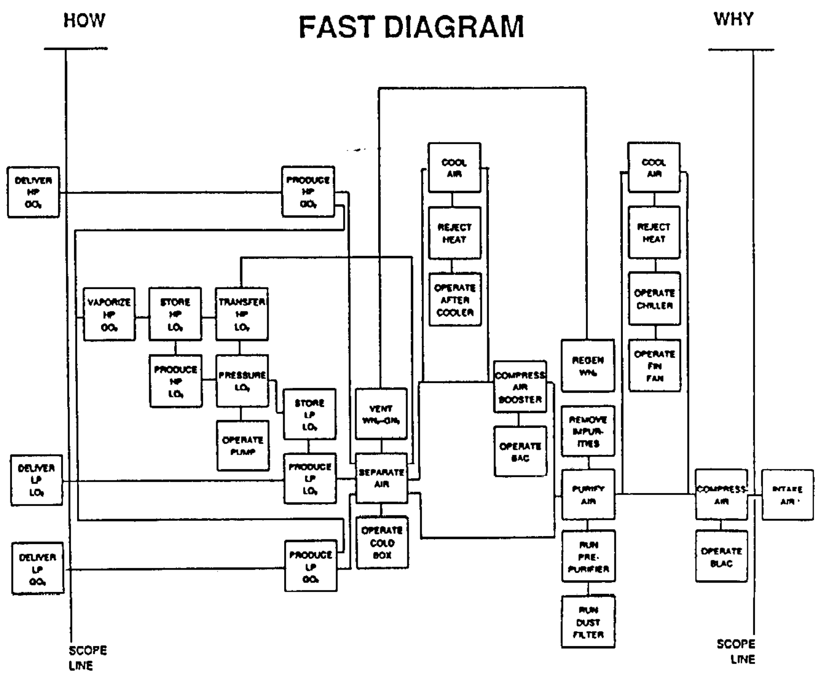
The scope and direction of the VE efforts will vary according to the type of project and the desires of the users, however, special techniques have been developed to assist in the application.

SPECIAL TECHNIQUES

FAST Diagram

Figure 1 is a FAST Diagram prepared for an air separation plant. The diagram was made to determine the functions being performed, their time relationship and to segregate and classify functions.

Figure 1
AIR SEPARATION FACILITY



The FAST Diagram is to give the VE team a greater understanding of the requirements and to assist in isolating poor cost/value areas or items.

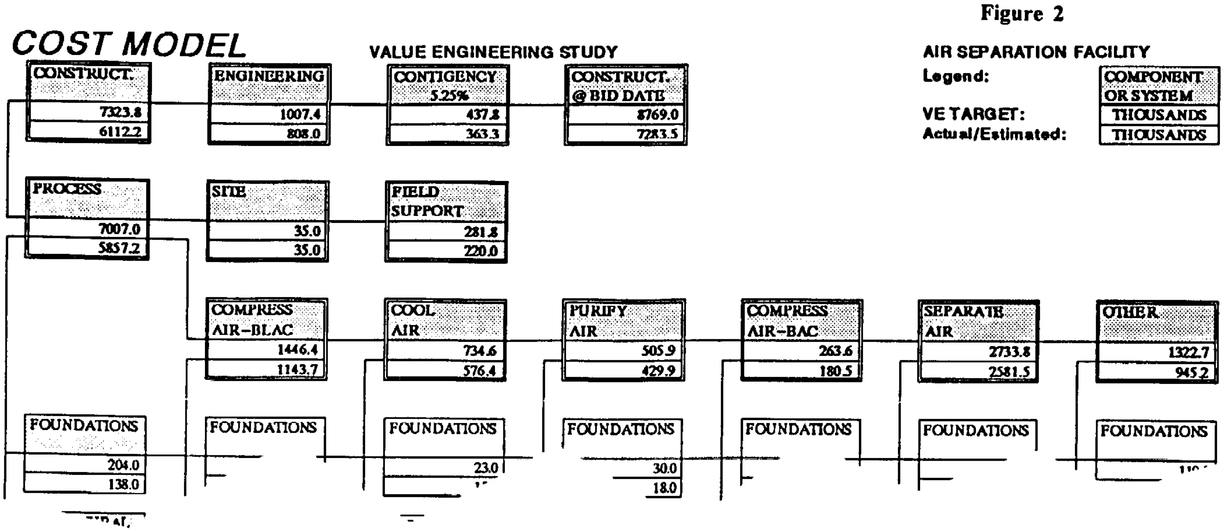
MODELING TECHNIQUES

Models are used during the information phase. The cost model identifies high cost areas; the energy model to identify potential energy savings areas; also, other models such as weight, space and LCC have proved valuable.

COST MODEL

Costs are the foundation of VE. The cost model is a tool that assembles and breaks down total facility costs into units that can be analyzed quickly. Figure 2 shows part of the cost model for the air separation facility (See FAST Diagram Figure 1). The model blocks out each major element in cost areas. The cost model should refer to a standard cost estimating system related to functional plant parameters. The cost system should be set up as a baseline for future automated cost control and estimating procedures oriented for design control. Costs are broken down by functional area, e.g., building, process, site, interface and operational support. This type breakdown can be more readily understood and utilized by designers than a trade oriented breakdown which, for example, lists the amount of concrete in a facility but doesn't indicate its usage.

Figure 2



The cost model includes two types of costs, the actual/estimated costs and the target cost. The value review team, augmented with costs expertise as required, develops the lower (dotted) cost breakdown of each block of the model using available or developed cost estimates. The model blocks are adjusted for each facility to better reflect thefunctional areas involved and the estimating techniques used. Normally, the team uses available estimating data, however, whenever data is lacking or its validity is suspect, the study input is augmented by a cost validation effort to secure more meaningful costs. Subsequently, target costs are developed. These are idealized costs based on team expertise and review of the basic functions of each cost block. These costs represent the minimum cost believed possible for each block of the cost model, and they are based on team experience with similar elements, cost files on similar facilities or previous study results.

These costs are added and result in a "Basic Cost Model" (solid block) representing idealized minimum costs. These become cost targets to compare with actual costs from the project estimate. Where the largest differences occurs between the actual and target costs, the area is isolated for study.

From Figure 2, the air separation facility cost model, the team thought a general cost saving appeared feasible. However, the major areas focused on were the air compressor (equipment), piping, electrical and instrumentation.

Figure 3 is a portion of a cost model developed for construction of an offshore gas/oil platform. The format of the cost model in this instance followed owner cost breakdown and was related as much as possible to the functional requirements of the platform. By examining the cost/target ratios in each of the cost centers, the team was able to pinpoint those with the least favorable ratios. For example, from the model the team decided to focus on the structural and equipment areas. From the study a potential savings of some ten percent of initial costs and an annual savings of some $2,000,000 were isolated). This model was used during the early design study. Based on analysis of the model, some five teams were organized and in-depth studies conducted. As noted, the plant was estimated to cost some $1.6 Billion. The team set up a goal of $1.4 Billion. The implemented results were savings of some $50,000,000 for a return of investment (ROI) of $300 savings for each $1 spent in VE. Operational savings of some ten percent/year were also realized.

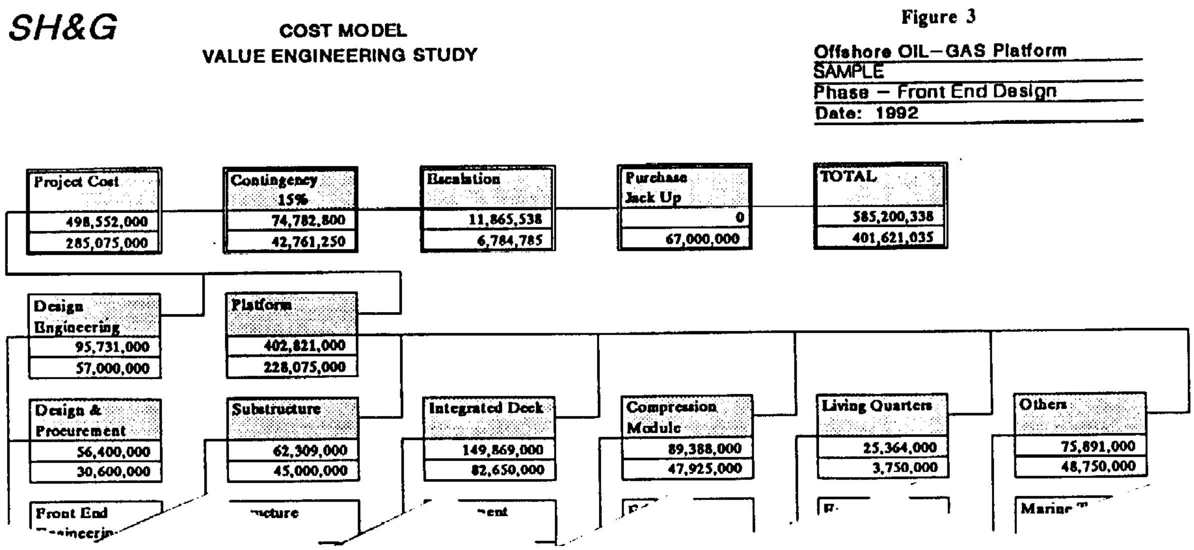


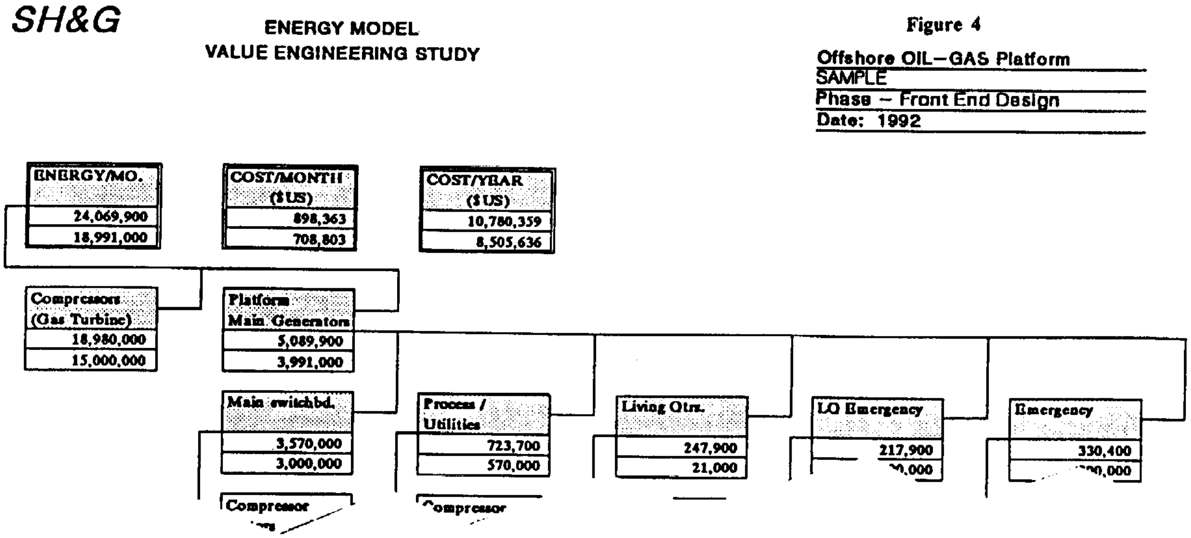
Figure 3

Use of a cost model is a basic approach to a VA/VE study, and as such, must reflect the "best" cost information available at the time of the study. With a cost model, a one-page visual analysis of the costs for the total plant is possible.

ENERGY MODELs

Similarly, a value program can be used to combat the sudden emergence of factors that were not significant items in previous studies. Since a continuation of rising energy cost is predicted, it is an area of prime concern for an owner/user over the life cycle of his facility. Development of an energy model, a spin-off of the cost model, is an organized approach to identify those operations having the least energy efficiency. Subsequently, the VE job plan can be used to develop alternate solutions to optimize energy consumption.

An example of an energy model (taken from the application shown in Figure 3) is illustrated in Figure 4. From the model, over a fifteen percent reduction in energy was isolated.



OTHER MODELS

As for other models, they are used for special circumstances where the efforts to develop them are greatly offset by significant savings potential. For example, in the aircraft/satellite area, weight is very important, as such a weight model would be appropriate, In a high rise building on a tight site, space is important, so a space model would be developed, In a process/product areas in a very competitive environment total product costs are most important, so a LCC model would be appropriate.

LIFE CYCLE COSTING

Another special technique used during a VE study is life cycle costing. For a VE study life cycle costing is defined as "an economic assessment of competing design alternatives, considering all significant costs of ownership, over an economic life using the concept of equivalent costs."Life cycle costing is used for studies where significant follow-on costs are visualized.

RESULTS AND FEES

As for fees, a study for the illustrated project (valued at $1 Billion plus) for a one time effort at approximately 50% complete design would approx-imate $115,000.

For the air separation facility illustrated by Figure 1 and 2, the VE effort was conducted in two phases, the fee for the two studies was approx-imately $50,000.

For the Directorate of Military Works in Saudi Arabia for a multi-billion dollar program some 10 full time VE specialist work on VE at an annual cost of some $1,500,000. The annual savings have averaged some $100,000,000. per year.

To reiterate, as a rough guide for the cost of VE for a large capital development program, VE study costs of 0.1 to 0.3% of total project costs should result in an effective VE program. These funds should result in a minimum of 5% savings in initial costs and a 5% follow-on costs savings in annual maintenance and operations.

CONCLUSION

Saving money is much more difficult task than spending money. Here are some conclusions that are recommended for further consideration when starting a VE program:

1. The organizational unit with overall fiscal responsibility should be involved in the effort. This fact is tantamount for overseeing implementation when cost savings needs to be evaluated against risk, time or quality factors.

2. A mandated program for VE should be established to realize savings not only for initial capital costs but also for follow-on LCC costs. There is as much or greater potential in follow-on costs/savings as initial cost savings.

3. The program should be automatically funded as a percent of capital expenditures. In addition, the program should be integrated into the design process. See attached Figure 5 which illustrates how our firm has integrated VE into the design approach.

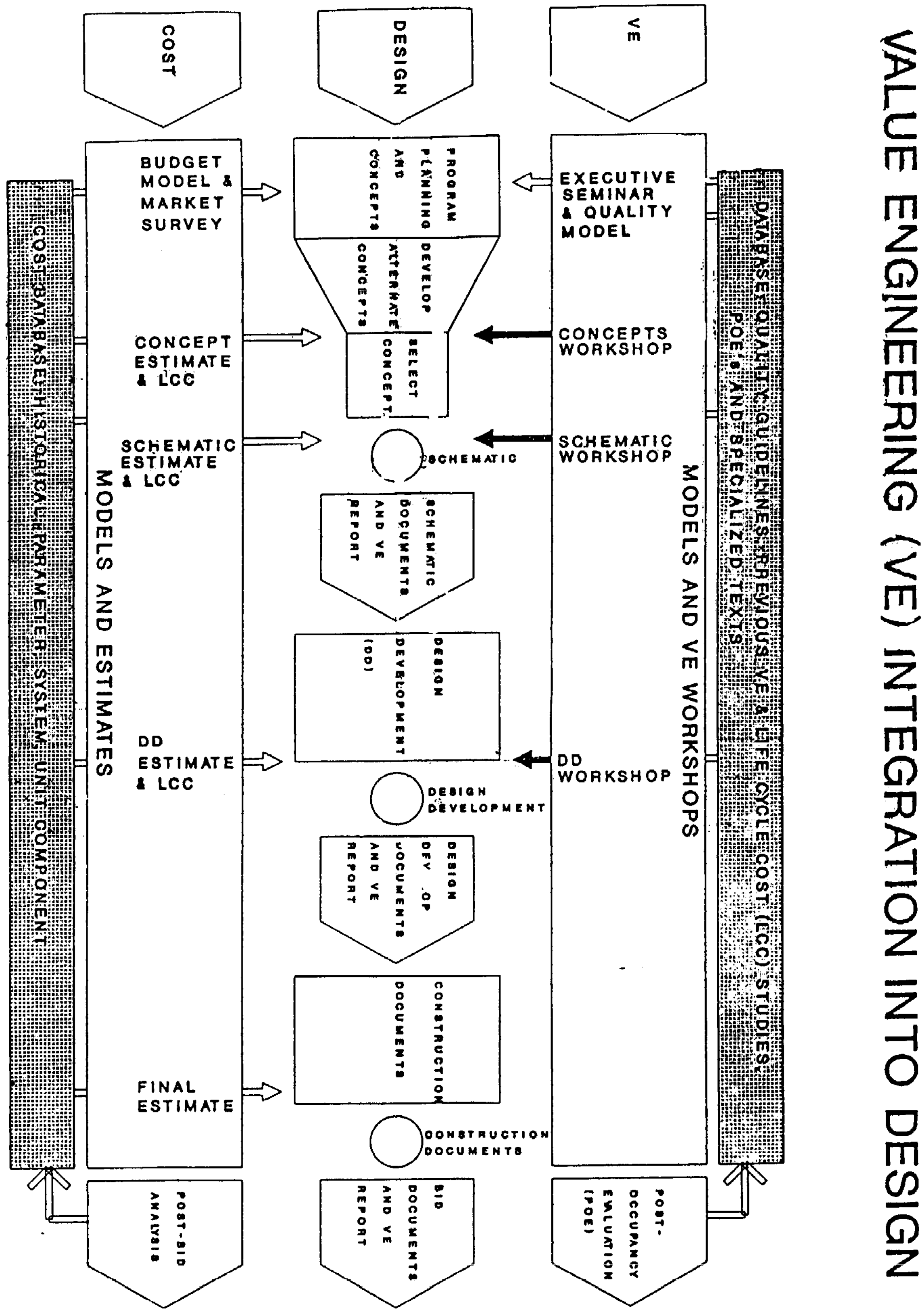

VALUE ENGINEERING (VE) INTEGRATION INTO DESIGN
COST
DESIGN
VE
BUDGET MODEL & MARKET SURVEY
CONCEPT ESTIMATE & LCC
SCHEMATIC ESTIMATE & LCC
DD ESTIMATE & LCC
FINAL ESTIMATE
MODELS AND ESTIMATES
PROGRAM PLANNING AND CONCEPTS
DEVELOP ALTERNATE CONCEPTS
SELECT CONCEPT
SCHEMATIC
SCHEMATIC DOCUMENTS AND VE REPORT
DESIGN DEVELOPMENT (DD)
DESIGN DEVELOPMENT
DESIGN DEV OP DOCUMENTS AND VE REPORT
CONSTRUCTION DOCUMENTS
CONSTRUCTION DOCUMENTS
EXECUTIVE SEMINAR & QUALITY MODEL
CONCEPTS WORKSHOP
SCHEMATIC WORKSHOP
DD WORKSHOP
MODELS AND VE WORKSHOPS
COST DATABASE: HISTORICAL PARAMETER SYSTEM UNIT COMPONENT
DATABASE: QUALITY GUIDELINES, PREVIOUS VE & LIFE CYCLE COST (LCC) STUDIES, POE'S AND SPECIALIZED TEXTS
POST-BID ANALYSIS
BID DOCUMENTS AND VE REPORT
POST-OCCUPANCY EVALUATION (POE)

Figure 5

4. In establishing requirements for implementing VE programs, goals should be set.

5. A training program should be initiated to teach the VE methodology and to create an enlightened awareness to increase the effectiveness of expenditures. Initially, it is required that a change in approaches and attitudes of key decision makers be achieved. The training effort should create positive attitudes for generating savings.

6. VE efforts should be initiated early in the design process. Application held during later design stages are limited because of schedule factors.

SUMMARY

A VE program can be an indispensable aid to a program manager in meeting the cost, quality control and energy reduction challenges of today and the future.

With the potential outlined in this paper, why not accept the challenge and implement a VE program!