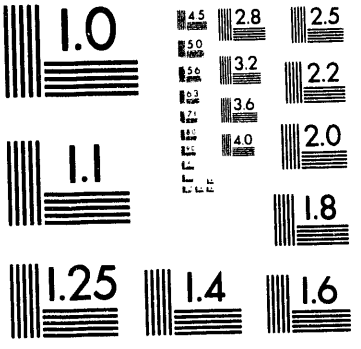

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
8.0
9.0

1 of 1

2

Conf-9304134--2

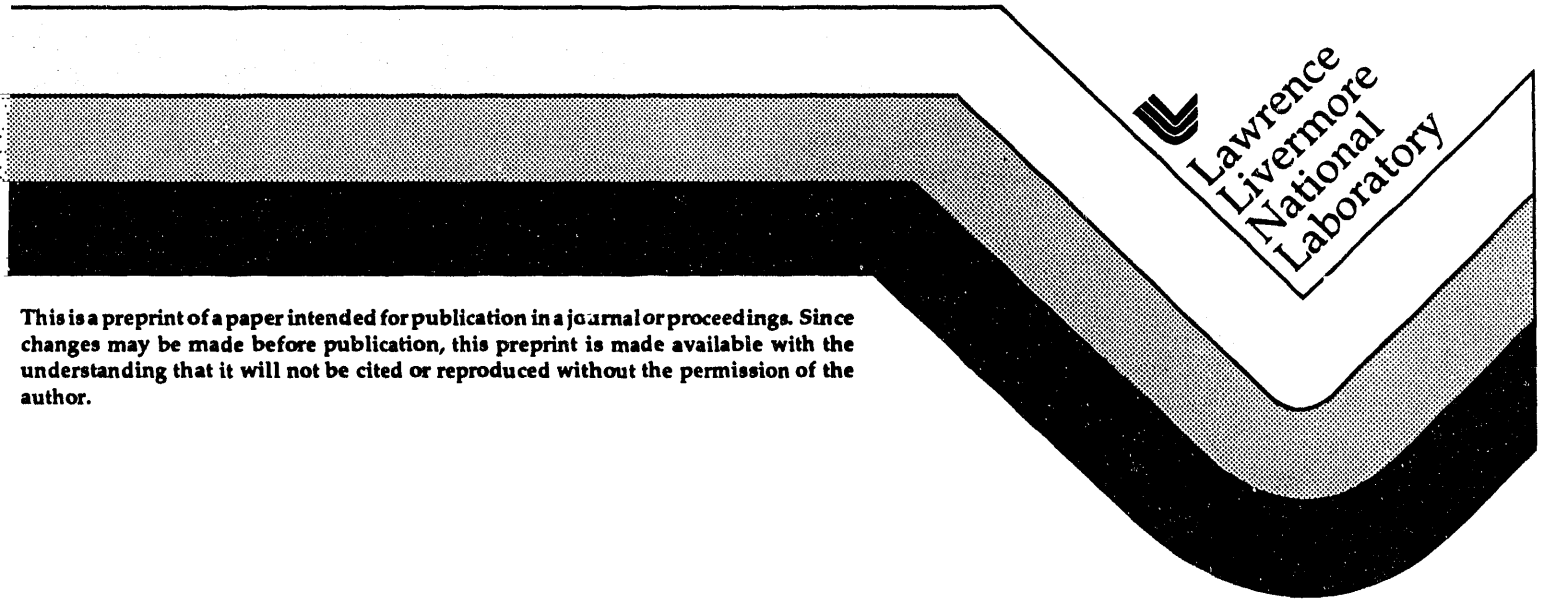
UCRL-JC-113556
PREPRINT

The VE/CAD Synergism

Roger B. Sperling

This paper was prepared for submittal to the
Third National DOE/Contractors Facilities CAD/CAE User's Group Meeting
Livermore, California
April 14, 1993

March 19, 1993



The VE/CAD Synergism

by Roger Sperling, CVS

for Presentation at the

Third National DOE/Contractors Facilities
CAD/CAE User's Group Meeting

Livermore, CA

April 14-16, 1993

ABSTRACT

Value Engineering (VE) and Computer-Aided Design (CAD) can be used synergistically to reduce costs and improve facilities designs. The cost and schedule impacts of implementing alternative design ideas developed by VE teams can be greatly reduced when the drawings have been produced with interactive CAD systems. To better understand the interrelationship between VE and CAD, the fundamentals of the VE process are explained; an example of a VE proposal is described and the way CAD drawings facilitated its implementation is illustrated.

INTRODUCTION

Value Engineering has been used at Lawrence Livermore National Laboratory in Plant Engineering (PE) for five years. CAD has been available for many more years and is recently growing in facilities design work.

This discussion traces a "collision" between VE and CAD that proved to be synergistic. It is in three parts:

- **Value Engineering - A Primer,** which outlines the group process used in VE

- **CAD - Designing for Change**, which summarizes one aspect of CAD's usefulness

- **VE plus CAD Equals More**, which describes the synergy that is possible between CAD and VE

VALUE ENGINEERING - A PRIMER

VE is a systematic process for analyzing facilities designs to improve functionality and reduce unnecessary costs. It is used in the product manufacturing environment where it was developed by Larry Miles in the 1940's. His function analysis of hardware at General Electric to solve materials shortage problems laid the groundwork for VE applications in the construction industry which began in the 1960's. Today the Society of American Value Engineers (SAVE) licenses Certified Value Specialists (CVS) to conduct value studies, and establishes manuals of practice for VE.

The VE Study Plan is the model for organizing VE studies; it contains eight specific phases: Information, Function, Creative, Evaluation, Development, Presentation, Report, and Implementation. Following these steps, the facilities design under study is examined in a creative environment by architects and engineers. The trend is to do VE earlier in the life of a project because it is easier and less costly to revise conceptual designs than nearly completed ones.

A study is conducted by a dedicated VE team, a multi-disciplinary group of independent professionals. The team is led through the process by a trained facilitator. Using function analysis they challenge the basic assumptions underlying the design and develop alternate solutions. Studies typically are five-day group meetings, focused entirely on one project. This intensive effort often yields surprisingly innovative design solutions.

The products of the VE study are an oral presentation and a written report which summarize the work of the team, with emphasis on the VE Proposals (VEP) which they developed. These VEPs discuss in some detail the as-designed method and proposed alternate method of satisfying the functions of the project, including comparative cost estimates.

One important aspect of the VEP cost estimate is the team's estimate of the cost of implementing the change. Many VEPs can be implemented with only minor cost impact, especially if the VE study is done early in the design cycle (Title I, 35%, or sooner). Some VEPs, however, have significant implementation costs, particularly when the VE study is done after the design drawings are 90% complete (Title II). These redesign costs can reduce the savings of the proposed change, or even "wash out" the projected savings.

An example of the successful application of VE at LLNL is the Westgate Badge Office project. One of the primary functions of the new visitor's entrance was perceived to be: project a "high-tech image" of the laboratory. One method used to fulfill that function was to design a space-frame roof support system. The VE team estimated that this structural system contained 26% of the $1.1 million project costs. Alternatives were proposed and costed. The final design used one of the suggested structural systems at a savings of $158K. Other changes, including the addition of two missing rooms, netted $320K in implemented savings, or 23% of the total project cost.

This VE study was done by one of our VE consultants. As the VE Site Coordinator I managed this study and have conducted other studies on smaller projects. Our average savings is about 10% of project cost; the return on investment (actual VE savings implemented/VE study costs) averages 16:1.

CAD - DESIGNING FOR CHANGE

My involvement with CAD has been at the design manager level. When I joined the PE mechanical design staff over five years ago we were working on a ventilation design project which was to be an "all CAD job". Because of inadequate planning the drawings were incomplete and poorly coordinated. We were forced to finish the drawings by hand to meet the schedule. Revisions were difficult with mixed hand/CAD drawings. After this experience we were reluctant to use CAD, except for occasional detail sheets.

Five years later, the design group decided to produce another "all CAD job". Because we were further along the CAD learning curve we improved coordination on this multi-discipline project and produced an excellent design package. We now are confident with CAD and see it as the design mode of choice.

One of my PE assignments was to chair the CAD Oversight Committee (COC) to recommend plans for using the existing centralized system to its best advantage. The COC focused on defining an effective network so that designers at satellite work stations could read drawings, make changes and refile them. This led to a fuller understanding of how we could manage our design work from the central CAD system.

Then I was moved to Fast Track, one of our satellite design organizations, and had the pleasure of helping make the network a reality. Now designers in a trailer complex one-quarter mile from the central CAD system work interactively on a daily basis with the central system to create new, or modify existing, design drawings.

So I know from experience that a well managed computer-aided design system produces quality designs. And one thing is perfectly clear: CAD drawings are easier to revise.

VE PLUS CAD EQUALS MORE

The CAD and VE universes collided for me in a "flash" when a VE study on a system of tanks plumbing, ladders and platforms reached the implementation phase. A decision was made to accept a VEP to delete an elaborate system of access steel in favor of temporary access (such as a cherry picker) for a significant savings. The estimate for changing the drawings, which were at Title II and virtually ready to go to bid, was estimated at approximately 10% of the calculated savings. This resulted in a net 90% savings.

Later when I saw the final drawings, the change recommended by the VE team had been made. Because the CAD drawings had been layered in such a way that the access steel was simply overlaid on the tanks, the design firm implemented the VEP very simply by deleting a layer of the drawing. They could have charged a reasonable fee for making this change. Instead, because CAD so greatly facilitated the alteration, no fee was charged.

The net effect was that there was no cost to making the change late in the design cycle. VE and CAD had collided synergistically to compliment each other by recommending and implementing a lower cost design idea.

This one example has been replicated many times on other projects, although in every case the VEP may not have been implemented as dramatically. However, because most changes on CAD drawings are faster and easier than the manual method, revised drawings can be produced more cost. effectively, thus yielding potentially greater net VE savings.

Value teams prefer to do studies on CAD-designed projects because the drawings are easy to work with; but more importantly, they know that more VE savings may be retained when their proposals are incorporated into the improved-value design.

SUMMARY

The use of CAD improves the quality of facilities design projects. It also helps improve the implementation of VE Proposals because design changes can be made simply and less expensively. This synergism means that the client can realize more fully the cost savings from VE studies. Together VE and CAD can improve the value of facilities projects.

ACKNOWLEDGMENT

This work was done under the auspices of the U.S. Dept. of Energy by Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

DATE
FILMED
10/20/93
END