USES OF VALUE ENGINEERING DATA

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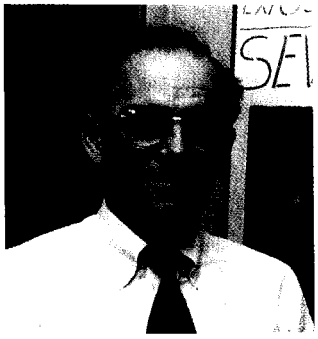

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ABSTRACT

This paper describes the Naval Facilities Engineering Command's VE Database Information System (VEDIS). Potential uses (and misuses) of this data are described as a guide to anyone who wishes to take advantage of this new technology.

INTRODUCTION

"In God we trust. All others must use data." [1]

The pursuit of improvements in quality, better products, improved customer service and personal satisfaction is everywhere we look today, in government as well as private enterprise. It is called by many names -- Total Quality Management, Total Quality Leadership, Continuous Quality Improvement, and others. By any name, the goal is the same -- improved success by increased attention to quality. W. Edwards Deming, known for his success in stimulating Japanese industry, has now been accepted as a prophet of quality in this country, and might be called the "Father of the Quality Improvement Movement." The use of data is integral to his approach.

As in the Scientific Method or the Information Phase of a VE study, improvements in quality begin with collection and analysis of data. This is vital before alternate courses can be charted. The Federal Express Corporation was the 1990 winner of the Malcolm Baldrige National Quality Award, the highest award possible in the area of quality for an American company. Federal Express invests 5% of its gross revenues in development and improvements of its management and customer information systems. [2] Improvements in VE may also be possible through the application of accumulated data.

This paper describes how data from past VE studies can be used to improve future VE and

design efforts. Comments made concerning use of VE data in this paper are meant specifically as they apply to construction projects, especially U. S. Navy facilities projects, as impacted by the VE Database Information System (VEDIS). Such comments may not be applicable to non-construction type projects.

HISTORY OF THE VE DATABASE INFORMATION SYSTEM

In 1989, before I began full-time work in VE, I wrote a dBASE computer program to assist the VE Coordinator at Atlantic Division of the NAVFAC. The purposes of this program were to (1) decrease reliance on clerical assistance for generation of spreadsheets used during VE resolution meetings and in final reports, and (2) establish a database of VE data for future use, which at that time were largely unknown. During the last several years, I have assisted the efforts to improve the VE master database and its related software programs.

The initial program relied upon two databases. One of the databases recorded general information about the study and the project studied (project name, project description, location, budget, facility type, cost of the study, implemented savings, return on investment, etc.). This database contains 90 such fields. The second database contained information about individual VE proposals (design discipline, a brief description of the suggestion, proposed savings, resolution, implemented savings, justification, etc.). This database contains 16 such fields. The two databases were related by a common field, the project job order number, unique to each project. Although improvements of the software program have brought about changes in these databases, they still contain the same types of information and are linked in the same manner.

In 1990, with NAVFAC and Office of the Assistant Secretary of Defense support, cooperation of the U. S. Army Corps of Engineers and part time programming and clerical support, data entry of historical records began. The program was also expanded to include limited query abilities (limited to a few selected fields). At this time, the program was compiled (converted) into an executable file, so that the program could be used without dBASE software. It became known as VEDIS, short for VE Database Information System. A second program was added for data entry, which was expected to be accomplished primarily by contractors and was therefore named VECON, for VE Contractor.

In cooperation with NAVFAC, the U. S. Army Corps of Engineers managed the development of a word processor format for entry of entire VE reports and standardization of printed VE study reports. It was called the VE Report Template (VERT). Use of VERT includes scanning of VE proposal sketches for a complete electronic record of VE studies. Together, VEDIS, VECON and VERT became the VE Support System (VESS). The long range goal was to develop a data entry and retrieval system which would allow a designer (or other user) to query on any field of the VEDIS databases and access all related information, including individual study information and individual proposal details, complete with graphics. As planned, the database would be available for use by any U. S. Government agency, for data input or retrieval.

In 1991, with professional programmer assistance (Softcost, Inc.), work began to rewrite the VEDIS and VECON programs as one, with the ability to query faster, on any database field, and with less required computer memory. The current version of that program is distributed worldwide on compact disc, with quarterly updates, as part of the National Institute of Building Sciences (NIBS) Construction Criteria Base (CCB). As distributed on the NIBS CCB, VEDIS can be used to input data, query data and print out a variety of standard reports. Data from over 20,000 proposals generated by over 600 VE studies (mostly NAVFAC) is accessible by the typical personal computer found in many offices throughout the world. The latest Windows version of VEDIS, exhibits improvements in query speed, available reports, access to full text VERT reports and is more "user friendly" than previous versions.

VE APPLICATIONS OF DATA

So now we have some data and a means to access and update the data, but what do we do with it, what are the pitfalls of its use, and how might they be overcome? Following is a discussion of the uses which are apparent at this time.

Use by Designers

Imagine an architect or engineer in the process of planning the design of a new facility. At his

fingertips there is information about the possible design options which have added value to past projects. He can access the information by facility type, approximate cost, size, key words, etc. All of this information is available within seconds. Figure 1 is part of a VEDIS report from a query of implemented proposals from projects of category codes which begin with "72" (unaccompanied personnel housing).

VALUE ENGINEERING PROPOSAL LISTING

Category Code	VE Proposal	Implemented Savings
721-11	USE PRECAST INTERIOR WALLS IN LIEU OF CMU	$464,396
721-11	REPLACE PRECAST CONCRETE WALL PANELS WITH STUCCO SYSTEM	$73,700
721-12	USE GYPBOARD NON-LOAD BEARING WALLS IN LIEU OF CMU	$69,400
...	...etc.	

Figure 1

The potential usefulness of this information appears obvious. Certainly these considerations at an early stage of design would make such ideas more a part of the design process, thus easier for the designer to consider, before the design becomes "carved in stone." Use of such information could strengthen the designer's case for his chosen design. In many cases, designers of Department of Defense facilities are already required to use CCB as a source of guide specifications. Since VEDIS and the master database are distributed on CCB, the only associated cost for use of the database would be the user's time. As a consequence, assuming some ideas are implemented as a result of use of the database, the return on investment would be extremely high.

Use by VE Practitioners

VE Practitioners (VE Team Leaders) could be assisted by use of VEDIS before and during VE studies. By querying on facility type, size (budget), proposal resolution and implemented savings, team leaders would have a "shopping list" of ideas to assist during the Creative Phase of the study. It should be noted that some creativity on the part of the team leader is required to turn what might have been a project specific proposal into something more generic for consideration by the VE team. For instance, a previously accepted proposal to change from a built up roof to a single ply membrane roof might best be expressed to the team as "consider alternate roof types." Further querying could assist the team in determining the potential acceptance of specific ideas generated during the study, thus providing assistance in preliminary judging of ideas.

Use by Design Criteria Specialists

In NAVFAC, a team of experienced engineers and architects are charged with establishing design criteria for use by in-house and architectural and engineering firms when designing facilities for the U. S. Navy. Similar positions, or sometimes groups or committees, exist in other government agencies as well as in industry. Personnel responsible for guide specifications, standards, codes, military handbooks, standard and definitive designs, manuals, etc. could benefit from the use of VE data to challenge that design criteria. How often have we heard good VE proposals rejected for reasons of conflict with established criteria? Challenges of design criteria in the time frame of an individual VE study is often difficult. However, during updates of the criteria, criteria specialists can use the database to challenge the established guidance. Figure 2 is part of a report from on a query of the VEDIS master database for implemented proposals (implemented savings > 0) and the key word "PVC" used in the proposal. A criteria specialist updating piping specifications might wish to review this list in the course of his update.

Repeatedly implemented proposals, even if they do not challenge established criteria, might be made a part of updated criteria by the criteria specialist. In this way all future designs can benefit from the "lessons learned" of the past. Future VE studies would then have to work harder to generate better ideas, thus improving the quality of the studies and the projects studied.

VALUE ENGINEERING PROPOSAL LISTING

Category Code	VE Proposal	Implemented Savings
510-10	USE PVC PIPE FOR CONDENSER WATER	$46,500
510-90	USE PVC PIPES IN LIEU OF COPPER	$30,000
151-20	USE SCHEDULE 80 PVC PIPE FOR THE SALTWATER SYSTEM	$140,562
213-30	USE PVC AND CPVC IN LIEU OF COPPER FOR POTABLE WATER	$25,240
...	...etc.	

Figure 2

Use by VE Managers

Those of us who are VE Managers for the U. S. Government are aware of the burdens put on VE programs by requirements such as those of Office of Management and Budget (OMB) Circular A-131. This circular established a threshold of $1M for VE efforts on U. S. Government "qualified" projects. There may be additional requirements of other federal agencies, and similar requirements in state governments and in private enterprise. We are also aware of constraints of our budgets and the need to put the VE dollars where they will do the most good.

Use of VE data can help us set policy in accordance with established requirements. For instance, the OMB circular tasks each agency to establish criteria for waivers of VE. Doubtless all of us can think of projects which exceed the $1 million threshold which have had poor return on an investment in VE. Querying the database on types of projects at various budget levels might indicate something about return on investment which should be considered when establishing criteria for waivers of VE. A query of the VEDIS master database yields the following result -- NAVFAC projects with an estimated cost of construction of less than $5 million are typically poor candidates for a formal VE study, if a 10:1 return is to be expected on the investment. Unless a project exhibits some unique characteristic which should be examined, if the project budget is less than the $5M range, a formal VE study will probably not be cost effective.

When considering a VE practitioner for performance of VE studies, data from past studies is useful in judging performance. Some practitioners might perform better on projects of a particular type and data from past studies can tell us that.

Another use by the VE coordinator is for generation of "lessons learned," previously accepted proposals which should be considered in future projects. I have developed a "generic" list of such proposals, as well as some which are specific to special types of facilities. See Figure 3. These are especially helpful to provide as guidance for designers when something less than a 40-hour VE effort seems appropriate, such as repetitive types of projects or projects with low budgets. Through comments received during their use, these "lessons learned" are in a constant state of update and improvement.

GENERIC VALUE ENGINEERING LESSONS LEARNED

Architectural Considerations

1. Consider alternate roof type, materials and slope.

2. Use exterior gutters and downspouts in lieu of interior roof drains.

3. Consider alternate exterior finishes (EIFS, brick, oversized brick, etc.)

4. Use steel stud and gypsum board interior walls when not load bearing.

5. Reconfigure floor elevations in order to lower the structure.

...etc.

Figure 3

VE managers are often required to provide reports on the results of their VE program.

"'Data volume has nothing to do with the accuracy of judgment. Data without context or incorrect data are not only invalid but sometimes harmful as well. It is necessary to know the nature of that data and that proper data be picked as well.'" [3]

In using VE data, or any data for that matter, one must recognize the inherent fallacies that may occur in that data and be ready to interpret the results based on this knowledge, or revise the query to accommodate the faults. There are no Data Police. Human error is always possible. Some understanding of the data is required. Data in the VEDIS database was accumulated over several years and comes from resolution reports the individual accuracy of which may vary. Sometimes data fields may be empty, improperly entered, or individual fields may be misinterpreted.

For example, suppose the master database were to be used to determine the likely return on investment (ROI) from a VE study for a training facility (170-00 series category code) with a budget of approximately $7M. Figure 4 represents a VEDIS report from a query which searches for projects with category codes beginning with "17" and budgets between $5 million and $7 million. Figure 5 is the report from the same query, expanded to exclude projects where VE costs are less than $10,000 (typically, in-house studies). Note the differences in the average ROI in these reports. This demonstrates that the user must recognize that some projects in the database are in-house studies, have lower VE study costs and as a result have a higher return on investment. This can skew the results of the query, if a study by a VE Contractor is anticipated

VALUE ENGINEERING STUDY LISTING

Category Code	Project Title	DDECC	Study Savings	VE Cost	ROI
171-00	AVIATION MAINT TRAINER	$5,310,000	$537,694	$27,172	19.8
171-10	ACADEMIC LIBRARY ADDN	$5,081,000	$127,000	$1,500	84.5
171-10	APPRENTICE TRAINING FACILITY	$5,596,000	$199,900	$33,179	6.0
171-15	RESERVE TRAINING & ADMIN CENTER	$5,329,000	$277,397	$24,359	11.4
...	etc.				
	AVERAGES	$6,430,789	$440,344	$23,480	18.8

Figure 4

VALUE ENGINEERING STUDY LISTING

Category Code	Project Title	DDECC	Study Savings	VE Cost	ROI
171-00	AVIATION MAINT TRAINER	$5,310,000	$537,694	$27,172	19.8
171-10	APPRENTICE TRNG FACILITY	$5,596,000	$199,900	$33,179	6.0
171-15	RESERVE TRAINING & ADMIN CENTER	$5,329,000	$277,397	$24,359	11.4
...	...etc.				
	AVERAGES	$6,611,286	$337,140	$26,561	12.7

Figure 5

The only "fix" for poor queries is understanding of the database and experience with its use. I recommend that the user phrase his/her query broadly at first, examine the results, and then refine the query as required. Through practice in creating queries and reports, and scrutinizing the results, valuable insights may be obtained. We must be careful, that in this technological era, we are not inclined to take a computer printout at face value only.

Lack of Reporting from VE Data Uses

One of the primary benefits of the use of VE data is the ability to apply VE "lessons learned" to more projects than would have been studied otherwise. But, with the use of such data, unless savings are calculated, there is no way to determine the resultant savings. In some instances, there is no way to calculate the savings, since the "lessons learned" may be considered before an alternative is designed in the first place.

From a documentation of savings perspective, this is really no different than VE studies which occur at or before preliminary designs are generated. This lack of reporting is the price of more widespread use and acceptance (hopefully) of VE. Actually, it could be a blessing in disguise. Through the application of VE principles in the form of VE lessons learned, I hope that VE will gain wider acceptance and more general use. After all, our primary goal should be to improve value, not document savings.

Databases in general, and VEDIS in particular, allow easy access to the information required, with the ability to print various reports quickly and easily and to organize and analyze the data in many ways. VEDIS contains several "standard" reports to assist in this effort. These reports may also be modified to add or delete fields or to change the format of the report if the user has access to R&R Report Writer software.

Use for Record Keeping

Storage space for printed records, as well as time spent cataloging and purging records is a needless drain of valuable resources. Many of us are subject to audit by internal and external agencies or groups. Searches for hard copies of past VE studies and implementation records can be time consuming and tedious. This process can be served better by data which is more easily accessible.

Use by Others

The Parametric Building Models under development for establishing budgets for Department of Defense facilities projects, make use of the master VE database. Doubtless, there are other uses of the data I have not discovered. I have noticed that as the database has become larger and the VEDIS program more sophisticated, more uses have become apparent.

CONCERNS REGARDING THE USE OF VE DATA

Common to applications of VE data are the following potential risks:

(1) If data is used in lieu of a VE study, there is the risk of not addressing project specific characteristics.

(2) Lessons learned may not be applied conscientiously by designers.

(3) Data flaws or a poorly defined queries can yield in poor query results.

(4) Measurement of the success of uses of VE data is limited.

(5) State-of-the-art design concepts may not be addressed by data.

Following is a more complete discussion of these problems and some means of mitigating these concerns.

Use of Data in Lieu of VE Studies

As discussed previously, repetitive types of facilities or projects with low budgets may justify the use of "lessons learned" from studies of similar projects. Project characteristics such as terrain, seismic criteria, base architectural requirements, and available utilities vary widely from site to site. As a consequence, if only "lessons learned" are used, these site specific characteristics may not be addressed.

Obviously the amount of effort to be expended on VE on any project must be based on the potential for an acceptable return on the investment. In low budget or repetitive type projects, we must first assume that a reasonable job of VE is accomplished by the "lessons learned" on the "non-site specific" portion of the project. To maximize the potential return on investment for VE on the rest of the project, participation by VE professional in predesign meetings or a brief review of the concept design (fewer team members, shorter review) can result in maximum value at the least cost.

Assuming that reasonable efforts are undertaken to incorporate VE "lessons learned" in design criteria, VE can become an integral part of the design process, even if not identified as a separate activity.

Fair Consideration of VE Lessons Learned

Whenever VE "lessons learned" are provided there is the potential that the proposals may not be fairly considered. This is little different than consideration of VE proposals from an individual VE study. That is, without some attention to the evaluations provided by the designers, there is no certainty that improved value is achieved. Consequently, whenever "lessons learned" are given to a designer, responses to each proposal should be made in writing for review by design reviewers, users and VE manager. Formal resolution meetings may be justified in some cases.

Whenever VE "lessons learned" are applied to projects which would not otherwise have been studied, the return on investment in VE is maximized because of the low cost of the VE effort.

Poor Queries

New Design Concepts Not Addressed by Data

When suggesting the use of VE data on projects, we must be mindful of the characteristics of those projects. We may have performed many VE studies on bachelor enlisted quarters (barracks), for instance. The resultant design criteria and "lessons learned" that can be gleaned from the VEDIS database is extremely useful for most designs. However, when there is radical departure from traditional designs, such as interior hallways versus the typical exterior balconies, a VE study may be justified as a source of new data. This can become part of organizational VE policy.

Even when there is no radical departure from past designs, new data must be generated to keep the database current with the state of the art of design, else "lessons learned" may become dated. Even if it is determined that a particular type of project should not be routinely studied, occasional performance of a VE study on selected projects will provided an opportunity to accumulate current data. It will also help determine how effectively "lessons learned" are being implemented on projects which no longer meet criteria for formal study.

CONCLUSIONS

Without data we could not make informed individual or professional decisions. By learning about it, using it and contributing to its improvement, we may improve the quality and acceptance of VE efforts.

Critical to the effective use of VE data is the VE professional. Good judgment plays a large role in any design. It is no less important in VE. At the heart of almost every solution to every problem associated with the use of VE data is the VE Manager/Professional. Through his/her efforts VE data can be used effectively to enhance and spread the role of VE in design.

The use of VE data in various applications related to facilities design involves some degree of risk. But without risk there is no change, and without change there is no improvement.

REFERENCES

[1] Walton, Mary, *The Deming Management Method,* Perigree Books, 1986, p. 96.

[2] *Blueprints for Service Quality, the Federal Express Approach*, AMA Publications Division, American Management Association, 1991, *p. 10-11, 60.*

[3] Walton, p. 96.