Abstracts

Value Engineering at Army Laboratories

Problems of Army Laboratories in identifying, achieving, and reporting Value Engineering (VE) are identified by Bruce Lackey. One is the rejection of acknowledged VE which takes place during the conceptual and original design phases. Another is in a requirement that VE must not only be new and improved, but unusual. Still another is that all engineering itself is not inherently acknowledged to be VE.

Solutions to the problems are offered, consisting essentially of recommendations to the Office of the Secretary of Defense (OSD) to not only broaden its viewpoint (which it has already done somewhat) but to publicize such a broad viewpoint, not only in the VE Program but also in the DoD Cost Reduction Program which is the almost exclusive organ through which VE results are reported. The (then new) problem of measuring VE results when the process is practiced during R&D is then identified, and a solution, based on a statistical approach is suggested.

Value Engineering and Configuration Management

The successful conclusion of a Value Engineering study involves "selling the idea." Thus the VE methodology is confronted with the discipline of Configuration Management. This paper by George Gebhardt examines the inter-relationship of VE and Configuration Management including the timing of various types of changes, information required to support the changes and contractual definition necessary to optimize contractor VE activity and the mutual benefit of both Government and the contractor. Charts utilized in the paper are derived from the AFSCM 375 series manuals and relate to the conceptual, definition and acquisition phase of a system program.

The Function of Worth

Tracing the use of value engineering upstream toward the source—an understanding of the concept itself—is the key to achieving the goal of cost avoidance and maximum savings. This paper contributed by Robert Thorsheim provides visibility in the use of the worth technique by answering the questions, "What does worth do?" "What can worth do?" and, most important, "Why?"

Worth is a much more versatile tool if the full spectrum of its use is understood. Understanding this tool begins when attention is focused away from the mechanics of "how" to determine the worth of a function, and toward an explanation of the function of worth itself.

V.E.—Yesterday, Today, and Tomorrow

C. W. "Smokey" Doyle, who has twice served as President of SAVE, reviews the significant milestones in the history of Value Engineering. He points out the basic problems faced by industry and government today. As the key to the future, he points out specific attitudes and actions which must be taken by VE practitioners, industry management, and the Department of Defense.
The President's Message:

The Next Link
In Our Chain of Progress

One of the most significant responsibilities of any professional society is to develop and expand the "state of the art" of the particular technical discipline involved. Our Society of American Value Engineers accomplishes this objective through the office of our Vice President for Professional Development and his technical committee directors. The success of these efforts will have a major effect on the continued growth in the application of value engineering techniques and principles.

Development of new approaches, however, is not enough. Dissemination of this information to our members is the next link in the chain of progress if we are to put these new developments into productive practice. The Journal of Value Engineering is our official medium for presenting new ideas to our members and the public.

To assure that high standards of quality are established and maintained, we have formed an Editorial Review Board to assist our managing editor in selecting those papers that demonstrate originality, clarity, and new creative approaches to our professional endeavors. Your suggestions and contributions are solicited in our common goal of making our Journal truly professional and the recognized authority in Value Engineering.

Frank J. Johnson, National President
Elbert Hubbard is credited with the observation that “no power on earth can stop a movement once its time has arrived.” Such would certainly have seemed to be the case with Value Engineering when the Office of the Secretary of Defense announced in 1963 that all contracts of $100,000.00 or more would require a Value Engineering Clause in the contract to assure that the government received a dollar value for every dollar spent. Any doubts that existed at the time regarding the sincerity of OSD should have been dispelled by Lyndon B. Johnson, President of the United States, who on December 2, 1963 advised:

“I HAVE ASKED THE SECRETARY OF DEFENSE TO TAKE INTO ACCOUNT THE ACCOMPLISHMENTS OF CONTRACTORS WHO SUCCESSFULLY REDUCE THE COST OF DEFENSE PROCUREMENT, WHEN MAKING FUTURE SOURCE SELECTIONS, AND IN DETERMINING PROFIT AND FEE RATES ON NON-COMPETITIVE NEGOTIATED CONTRACTS.”

These positive statements together with the aggressive actions which followed were hailed as the long awaited renaissance by those individuals and associations who had championed Value Engineering as a new dimension of Management. Eager exponents started a mass parade before every available lectern to trace the history and growth of VE and to point to the unprecedented returns on investment which could result from a results-oriented program. The enthusiasm and elation of these individuals is quite understandable when one considers the years of frustration, roadblocks and attitudes that seemed to resist their efforts at every turn. Historians of the program pointed with pride to the pioneering efforts of Lawrence Miles, the beloved Father of Value Engineering Analysis, and his determined, patient efforts to overcome generations of bad habits and attitudes. If there was one factor that emerged with crystal clarity it was the fact that the problem was indeed a “people” problem and not a weakness in the methodology of VE per se. Miles himself recognized this formidable roadblock as witness his early thoughts regarding the contributing factors associated with unnecessary costs. Miles stated:

“On the average, one-fourth of all operating cost is unnecessary, the extra cost continues because of patterns and habits of thought, because today’s thinking is based on yesterday’s knowledge.”

Miles further recognized that inherent within the philosophy of Value Engineering was the implied criticism that a better job could be done. Early presentations are replete with the admonition that all aspiring practitioners recognize the important element of “human nature” and “human relations.” It became obvious that communications was one of the most important challenges confronting the program and the practitioner. At the risk of over simplification the major problems that existed could be narrowed down to two categories:
1. Those who were convinced that VE was an embryonic cult that at best was simply “old medicine in a new bottle,” and

2. Those who were convinced that they had been practicing VE for years and years due to the competitive nature of their business and their own personal cost consciousness.

Time and results in terms of millions of dollars have all but negated the first category. Unfortunately, the documented results of the program have only served to strengthen the latter. There are still those who are sincerely convinced that they are practicing the methodology of Value Engineering but who have never truly understood the difference in the functional approach of Value and the conventional approach of cost reduction.

While it is not my purpose to discuss the methodology of VE in this paper I do want to emphasize this point. Good Value Engineering does not just happen in the normal course of doing a good job. VE is a purposeful organized program which first identifies the function(s) required, and applies the use of specific techniques to provide those functions at the lowest total cost without degradation of required quality, performance or reliability. The next significant milestone in the Development of VE was the release of Defense Procurement Circular No. 11 in late 1961. This document added three important new elements to previous ASPR (Armed Services Procurement Regulation) coverage. They were:

a. Extended contractor sharing to VE savings realized in follow-on contracts (future acquisition savings).

b. Extended contractor sharing to VE savings in operation, maintenance, logistic support, and Government Furnished Property (collateral savings).

c. Encouraged subcontractor VE programs and clarified policy permitting prime contractor to count subcontractor’s share of VE savings as part of cost to implement a VE change.

Assistant Secretary of Defense Thomas Morris, Deputy Assistant Secretary of Defense George E. Fouch, and an impressive panel of military personnel together with knowledgeable industry representatives conducted a tour of 5 major areas in the United States for the sole purpose of acquainting industry management with the expanded opportunity offered by these three elements.

At this point in our brief review of history, logic would lead us to believe that in the words of Hubbard, “the time of Value Engineering had arrived.” Unfortunately, nothing could be farther from the truth. Before I am accused of heresy let me qualify my previous statement. No one can deny the tremendous contributions to the national economy that accrue to those managements who aggressively pursue better value through a results-oriented Value Engineering program. The dilemma, however, is that neither industry nor the Department of Defense is realizing more than a fraction of the potential value available to them.

Let us attempt to justify this conclusion by reviewing the DOD reports for fiscal 1967 as seen in Chart I. Savings to the Department of Defense from VECPs (Value Engineering Change Proposals) declined in both numbers and dollars when compared to FY 66. As indicated by the chart the number of VECPs decreased from 982 in FY 66 to 802 in FY 67. There was a decline from $47.1 million to $38.5 million in dollar value over that same period of time.

Chart II indicates that eight contractors saved the Department of Defense over $1 million each in FY 67. These eight contractors accounted for approximately 15 percent of the total estimated savings to DOD from all FY 67 VECPs. Incidentally, the contractors’ share under the incentive provisions of their individual contract ranged from about $100,000.00 to $2 million.

The significant thing here is that only eight contractors saved DOD as much as $1 million in FY 67 through high-dollar VECPs. When one considers the defense budget and the number of active defense contracts in existence these statistics are startling.

As startling as chart II is, it still offers a vivid contrast to chart III. Chart III indicates that eight contractors with a combined total of over 3 billion dollars in DOD business failed to turn in a single-high-dollar VECP.

Looking at VECP performance further by means of chart IV, we find that the military approved a total of 84 high dollar VECPs received from some 34 major contractors. Although the total savings may be impressive at first glance, they become relatively insignificant when compared to the total business indicated on the right of the chart.

In summary one must conclude that:
1. Large individual targets of opportunity are being lost to both industry and to DOD, and

2. The reports for FY 67 verify a lesser achievement than was reported in FY 66.

It should be obvious at this point that we are confronted with a strange paradox. First — we have a proven methodology that will infallibly lead to better value. Second — despite a proven record of accruing benefits to both the contractor and the military we continue to barely scratch the surface of the ultimate potential savings. If we accept the premise that the program is not at fault, then what are the factors creating the paradox? Here again I believe the answer is obvious. The problem is a “people” problem. Yes, how ironical that some twenty years later we re-discover the very same problem that Larry Miles identified as the major problem existing in 1947. Not only is the problem one of “people” but communications continues to be the weakest link in our chain of progress. It is not my objective, nor could any purpose be served, to point fingers or attempt to fix the blame on any single organization or individual. I feel very strongly, however, that the time is long overdue to call spades, spades, and bring the issue into the open. Further vacillation or attempts to ignore the facts can only compound the problem.

During two terms of office as President and Chairman of the Board of the Society of American Value Engineers, I was privileged to travel extensively throughout the United States and Canada in connection of the Society of American Value Engineers
with the duties of those offices. The conclusions and remarks in the balance of this paper, therefore, are not the result of evaluating any single contract, contractor or military agency. They do represent a composite summary of the total picture as viewed from experiences and contacts during that period of time.

I am convinced that the blame for our paradox cannot be isolated per se but must be equally shared by all parties involved; i.e. a. The Department of Defense; b. Industry top management; c. The Value Practitioner. I will discuss these in order.

What at first were discredited by the military as idle allegations and foot dragging tactics on the part of industry have now been proven to be more fact than fiction. The bitter truth is that in far too many instances middle management within the military is not following the policies of DOD. Conversely, there is evidence that in some cases Value Engineering is being actively discouraged. Contract administrators have openly voiced their opposition to what they call the opportunity of contractors to “reap windfall profits.” Contractors who invest their own funds in Value programs are running head-on into the attitude that, “You should have done it right the first time. We have no intention of rewarding you for correcting your errors.” There is an alarming number of cases wherein a contractor is denied an incentive under the value engineering clause only to be told later to “make the change through the standard engineering change procedure.”

These remarks should not be construed as criticism of DOD or their efforts to establish policy and motivate results producing Value programs. No one could have worked harder to “sell” the program or to make it more attractive to industry than has the top level of DOD. The problem is one of communicating these objectives to the lower echelons who must initiate the actions and create the environment necessary to maximize the potential of Value Engineering. Military program managers must understand that a contractor’s incentive share is awarded only after an equal or greater share of the savings accrues to the government. In fact DOD figures show that on the average, the government’s share has been 70 cents on the dollar when considering all types of sharing arrangements.

CHART II

ESTIMATED SAVINGS TO DOD FROM CLASS I VECPs** SUBMITTED BY 8 MAJOR DOD CONTRACTORS FY 1967

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Savings to the DOD (Millions)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>$5.0</td>
</tr>
<tr>
<td>2</td>
<td>4.5</td>
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<tr>
<td>3</td>
<td>3.0</td>
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<td>4</td>
<td>2.7</td>
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<td>5</td>
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<td>6</td>
<td>1.8</td>
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<tr>
<td>7</td>
<td>1.2</td>
</tr>
<tr>
<td>8</td>
<td>1.1</td>
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</tbody>
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$21.3

**High Dollar VECPs with Estimated Total Savings at least $50,000 before sharing.

Source: DOD VECP Reports—FY 67

Before leaving this item I would like to assure you that positive action is being taken to correct the situations just discussed. Because of its importance to the question I would like to quote verbatim a letter from Robert S. McNamara, Secretary of Defense, dated 5 January 1968, and addressed to all Secretaries of Military Departments and the Director of Defense Supply Agency.

“It has been alleged that Value Engineering Change Proposals submitted by Defense contractors are not, in many cases, receiving prompt attention by our procurement and technical management personnel. Further, there are allegations (which, if true, are even more disturbing) to the effect that in some cases Value Engineering Change Proposals submitted by Defense contractors are being converted by our technical and/or procurement management personnel to Engineering Change Proposals. If true, these practices would surely negate incentive-sharing arrangements.

“Contract incentives in the Value Engineering Program and the ASPR clauses which implement them are designed specifically to motivate contractors to invest their own funds in value engineering efforts under Defense contracts. The practices described above virtually destroy this motivation.

“Value Engineering Change Proposals submitted by Defense contractors not only deserve prompt attention but also fair treatment and consideration. Anything short of this discredits the personnel of the Department of Defense and stifles the initiative of Defense contractors in providing us products at the lowest sound price.

“Each Department should take prompt action to correct any practices which are inconsistent with our fundamental value engineering policies and to emphasize the importance of this matter to all personnel involved in processing and approving Value Engineering Change Proposals. Accordingly, please advise me by January 30, 1968 of the steps you are taking to look into these allegations and, if found valid, to correct them.”

Signed/Robert S. McNamara

An example of the action stimulated by the Secretary’s letter is a communication dated 25 January from General James Ferguson, Commander, Air Force Systems Command, on the same subject. General Ferguson opens by referencing Secretary McNamara’s letter and then adds:
"The Secretary cited two specific instances in which he continues to receive complaints from industry; however, I am aware of other complaints which require action on your part."

Following a point by point discussion of the problem areas General Ferguson closed by saying: "I will expect to see improved management visibility in the areas mentioned. I further request a report identifying planned corrective action for any aspect of the V.E. program where deficiencies exist. It is desired that you submit this report no later than 29 February 1968."

My point in referencing these two letters is to offer conclusive proof that DOD recognizes the problem and is taking specific action for correction.

This raises the interesting question of whether or not industry is equally willing to evaluate its efforts and to take comparable action to correct deficiencies?

In turning our attention to industry management and the value practitioner I believe that the two are so closely related they can well be addressed jointly. In fact, I would like to take a somewhat different approach than that used in discussing the problem within the military. I propose instead to make some basic assumptions and then ask some specific questions. My objective in this approach is to assist both management and the practitioner to evaluate their own programs and efforts.

First, I want to suggest that top management in a competitive business environment has two basic objectives that justify its existence. They are:

1. To create opportunity and markets, and
2. To return a reasonable profit to the stockholders.

It would seem to me, therefore, that any individual member of a management team, in any functional area must be concerned not only with a superior competitive posture, but be equally concerned with maximization of return on investment in terms of profit. I find it difficult to imagine any individual in a management environment who would not welcome with open arms any proven program or technique that could contribute to these objectives. My question then must be directed to the practitioner. Are you still talking in terms of the philosophy of Value Engineering, or have you converted your language to the commonality of the objectives of Value Engineering and the objectives of management?

Have you emphasized that Value Engineering never degrades required performance, quality or reliability? Assuming the answers to these questions are in the affirmative, let me now direct my questions to the program itself.

1. Is specific responsibility for managing the value program assigned?
2. Are there detailed procedures that outline the specific responsibilities of each individual involved in developing and processing a value change proposal?
3. Do you conduct formal Value Engineering workshops to expand your in-house capabilities?
4. If so, does this training include Design Engineering, Purchasing, Contracts, Tooling, Manufacturing, Quality Control, Reliability, Cost Estimating, Industrial Engineering and other functional areas?
5. Do you motivate sub-contractors to establish value programs by including incentive provisions in their contracts?
6. Are goals established for each line department and specific responsibility for coordination and reporting assigned?
7. Are you satisfied with the results of your program to date?

Admittedly I have asked this question in the hopes of further stimulating self-evaluation. It goes without saying that in the final analysis RESULTS will determine the success or failure of any program.

In one of the earlier charts we indicated that only eight contractors had successfully "sold" high dollar VECPS of $1 million or more value. Was your company one of these eight top contractors?

Up to this point we have discussed the results of fiscal 66 and fiscal 67. Now for a moment let us look at the first quarter of fiscal 68. DOD reports savings for the first quarter of fiscal 68 from VECPS at the rate of $100 million per year. Using a rule of thumb of 30 percent as the contractor's share, indicates that successful contractors will receive VECPS shares in the $30 to $40 million range. It hardly requires a slide rule to recognize that this is the equivalent of $500 to $700 million of sales. The provocative thing is that some contractors, despite all the difficulties enumerated, are realizing significant returns on investment from effective Value Engineering efforts. The question that must be asked is — are we, as individuals, part of the problem or are we finding the solution?
Value Engineering is fraught with many problems. These vary in relative importance, in many cases, in accordance with the organizational situation of the individuals attempting to perform it. The observations herein concern the problems of Value Engineering which have special importance at Army Laboratories.

No particular laboratory is singled out.

The Problem of Definition

Over all the subordinate problems stands the perennial, universal one of semantics — of definition. The American Management Association devotes a chapter in its booklet, Value Analysis/Value Engineering, to "The All-Important Definition." In this 16-page chapter the author gives us a definition in 40 words and then takes 7 1/2 pages to explain it. The remaining 8 1/2 pages admirably amplify the definition and the explanation, and at the same time spread a little propaganda as to why and how to perform Value Engineering/Value Analysis.

If only the term had been copyrighted we might all happily be forced to use the definition given by the acknowledged "father" of Value Engineering, Lawrence D. Miles, in his book, Techniques of Value Analysis Engineering:

"Value analysis is a philosophy implemented by the use of a specific set of techniques, a body of knowledge, and a group of learned skills. It is an organized creative approach which has for its purpose the efficient identification of unnecessary cost, i.e., cost which provides neither quality, nor use, nor life, nor appearance, nor customer features."

Unfortunately, copyrighting of the term did not take place, nor did Mr. Miles stipulate just what "specific set of techniques," what "body of knowledge," and what "group of learned skills" would be absolutely necessary to permit categorization of an action as true VE/VA.

Lt. Col. Bert Decker has helped to clarify the semantic obfuscation with his reports, "Advantageous Definitions Concerning Value" and "Advantageous Definitions Concerning System Value," but he has not yet published a definition of the total phrase "Value Engineering" or of the total phrase "Value Analysis."

The Department of Defense has focused national attention on Value Engineering. As one writer states, "Mr. McNamara has done for this new approach what the federal income tax law did for accounting." Through its program clauses and the incentive-sharing clauses in its contracts, the DoD has obtained Value Engineering consideration in the development and production of defense items. Industry has not failed to recognize the advantages of VE and has applied the concept to commercial products as well. But, in jumping into the pond, the DoD created waves that have not yet subsided; it has thoroughly muddied the waters; and its continued splashing about prevents them from clearing.

Robert L. Crouse (Manager of Value Engineering and Industrial Engineering, Aerospace Division, Honeywell Corporation, and Donald E. Redmon (U.S. Army Materiel Command Value Engineering Program Manager) like to recount their participation in the initial introduction of Mr. Miles' VA techniques into the Department of the Navy in 1954, and in the decision made then to call it Value Engineering. The system was given Defense-wide recognition. Among the documents issued was Handbook H-111, containing a definition (now superseded) which limited the scope of VE to "defense hardware."

In initiating the Department of Defense Cost Reduction Program in 1961, the Secretary of Defense established a category called "Eliminating Goldplating (Value Engineering)." Discussion has raged ever since as to whether or not the two parts of the category are to be considered synonymous. The two schools of thought on the matter lead back to two different Deputy Assistant Secretaries of Defense, neither of whom appears to be about to refer the question to the Assistant Secretary or to Secretary McNamara himself. An impasse has therefore been reached. The disagreement was moot, however, since whenever there appeared to be a difference, the broader of the two aspects was used to qualify actions for inclusion in Cost Reduction Reports.

This situation held true until publication of the most recent DoD guidance for that program (DoD Instruction 7720.6, May 19, 1967), under which it is now required that for reporting under "Category I.C., Eliminating Gold-
plating (Value Engineering)" the action must be processed as a formal Value Engineering study, replete with various requirements and culminating in a written proposal.7 "Spontaneous" decisions to improve processes or to avoid unnecessary costs must now be reported under "General Management Improvements."

While the Cost Reduction forces of the Office of the Secretary of Defense have thus been narrowing the scope of "Category I.C., Eliminating Goldplating (Value Engineering)" to cover only Value Engineering (and at the same time refusing to purify the title to match), the Value Engineering forces have been broadening the definition of VE itself. In a pamphlet entitled Reduce Costs and Improve Equipment Through Value Engineering, prepared by the Department of Value Engineering, Office of the Assistant Secretary of Defense (Installations and Logistics), issued in January 1967, a very broad definition of VE is given:

Value engineering is defined as an organized effort directed at analyzing the function of DoD systems, equipment, facilities, procedures, and supplies for the purpose of achieving the required function at the lowest total cost of effective ownership, consistent with requirements for performance, reliability, quality and maintainability. Value engineering may also be considered as a systematic and creative approach for increasing the "return on investment" on specific components, weapon systems, facilities, or any other items procured by the DoD, with no loss in required performance or function.

The term "return on investment" is used here in its broadest context and could mean many things. It might mean lower acquisition costs, but it might also mean lower total cost of effective ownership by decreasing logistics and operational costs although increasing acquisition cost. An imaginative value engineering program, for example, can have the effect of implementing quality and reliability objectives by simplifying design and focusing testing and inspection on essentials.

"Return on investment" might also mean more defense capability in a weapon system for the same amount of dollars. VE can be considered as a tool capable of making desired military capabilities economically feasible, as well as a tool for cost reduction.

To industry, "return on investment" could mean increased profits or an improved competitive position. Actually, results to date clearly show that VE does add a new financial dimension to the aspect of defense contracting.

It is important to understand that value engineering is more than what is normally considered as cost cutting. To many individuals, cost cutting means reviewing things as they are in order to reduce their cost, whereas value engineering is a more fundamental and systematic approach which takes nothing for granted. The VE technique evaluates all attributes of a product — including its very existence — subject only to the restriction that the required function, performance, reliability, quality, and maintainability must not be degraded and must be available within the required time period.

The point is that this definition is basically concerned with VE decisions and results, and is not restrictive as to how they are achieved. With respect to technique, it does not require that there be a formal proposal. It does not require that the procedure be — or even be capable of being — split into phases such as Information, Speculation, Planning, Execution, and Reporting. It does not even mention that "brainstorming" is recommended. It does not specify that there must be a team of two or more individuals. It does not even require that the "worth" of the function(s) be established. In sum, under the above-quoted definition, any overt action with value-beneficial results can be categorized as Value Engineering.

On page 7 of the same pamphlet are given the definitions of seven "factors" which "account for" many successful Value Engineering studies, as follows:

- **Advances in Technology**: Incorporation of new materials, components, techniques or processes (advances in the state-of-the-art) not available at the time of the previous design effort.
- **Additional Design Effort**: Application of additional skills, ideas, and information available but not utilized during previous design effort.
- **Change in User's Needs**: User's modification or redefinition of mission, function, or application of item (change in user needs).
- **Feedback from Tests/Use**: Design modification based on feedback from user tests or field experience suggesting that specified parameters governing previous design were unrealistically or exaggerated.
- **Questioning Specifications**: User's specifications were examined, questioned, determined to be inappropriate, out of date, or overspecified.
- **Design Deficiencies**: Design in use prior to VE change proved inadequate in use (e.g., was characterized by inadequate performance, excessive failure rates, or technical deficiencies).
- **Excessive Cost**: Design in use prior to VE change proved technically adequate, but, through use of a cost model or comparative costing techniques, it was determined that the cost of that design was excessive.9

Note that these actions are not included as a part of the definition of VE; but it is accepted that, for example, successful VE action may be achieved through "incorporation of new materials, components, techniques or processes (advances in the state-of-the-art) not available at the time of the previous design effort." Let us therefore hope that the auditors will forget that last year the Department of the Army published, in Circular 11-10, the following contradictory guidance:

2.d.(5) The following actions are not considered reportable value engineering savings from research and development in-house and contractor activity even if they result in savings:

- (a) Redesign primarily to correct unsatisfactory technical performance, reliability or maintainability.
- (b) Redesign of an item being used because there is nothing better at the time and an improved design is considered essential for final acceptance.
- (c) The normal utilization of advances such as the use of high-speed data processing equipment which replaces manual procedures.

It is a relief that the Army omitted these restrictions in its new guidance, AR 11-20, July 1967.

There is a beautiful little gem in the "DoD Cost Reduction Program" guidance (Instruction 7720.8), in which it is admitted that Value Engineering does take place during R&D (and even in the conceptual phase), and that this is possibly the most important time to apply VE; and yet — non sequitur of non sequiturs — because it is a more or less "normal" function, such VE is not to be reported:

J. Application of Value Engineering during Research and Development.

1. The Research and Development phase of an item or project represents one of the most opportune times to apply the techniques of VE. It is better to eliminate unnecessary specifications prior to production than make changes after an item is being produced. However, progressive definition of a work scope and changes in design normally occur during Research and Development. Therefore, only those changes which result from a VE action taken subsequent to design engineering approval by the department responsible for the basic design, qualify for reporting in this area.11

The Cost Reduction Program in all areas has been limited to reporting "new, improved, or intensified" actions. Whenever a special "study" is made resulting in...

* Emphasis added.

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the recognition of and consequent decrease in the requirements for Major Items, it is reportable. The same holds true for Secondary Items. All procurement personnel are directed to procure competitively, to engage in Multi-Year Contracting, and/or to "break out" into direct purchase, whenever these procedures are practicable. This is their normal function, and their cost savings results are reportable. Entire organizational segments have been established to introduce all practicable new use of ADP. This is their normal function, and yet all the cost benefits derived therefrom are reportable. And so on for all the areas. For Value Engineering, then, one wonders why the actions have to be "non-normal" and whether this means unusual, peculiar — or even queer?

One final observation on the definition of Value Engineering. Under the terms of the newest section of ASPR just released, for the purposes of incentives to contractors, VE by a contractor is "contemplated" rather than "defined" as "a systematic and creative effort, not required by any other provision of the contract, directed toward analyzing each contract item or task to ensure that its essential function is provided at the lowest overall cost." In the next paragraph ASPR states: "While most proposals will result from the contractor's value engineering efforts, any proposal submitted by the contractor which meets the documentation and other requirements of the value engineering clauses may be rewardable."

Having dealt with the indefiniteness in the multiplicity of definitions of Value Engineering but so far only hinted at the problems caused thereby, let us now consider the definition of Engineering.

The Minnesota Society of Professional Engineers, in a leaflet entitled Wonders of Engineering in Minnesota, 1967, states that:

Engineering is a profession in which the principles of mathematical and natural sciences are applied, with judgment, to the development of ways to utilize most economically the materials and forces of nature for the benefit of mankind.

This definition stands although, as is observed in the next sentence:

Today, there is a trend away from engineering as an empirical discipline toward one in which the basic principles of scientific laws and mathematical techniques are creatively used for technological development. Prime emphasis is less on the developments of engineering themselves but rather on the planned and organized use of scientific laws and mathematical techniques.

The 81st Congress, in its Public Law 789, "Professional Engineers' Registration Act," defines engineering as:

the performance of any professional service or creative work requiring engineering education, training and experience, and the application of special knowledge of the mathematical, physical, and engineering sciences to such professional services or creative work as consultation, investigation, evaluation, planning, design, and supervision of construction ... The term "practice of engineering" comprehends the practice of those branches of engineering, the pursuit of which affects the safety of life, health or property, or the public welfare.

The Problem of Evaluation

How does all this lead up to problems at an Army Laboratory? If we look at a summary of the "Mission Statement" of a typical laboratory, we will find that the organization is nowhere required to include economic considerations in its operations:

(1) Perform basic and applied research, development engineering (including prototype model production and related industrial and maintenance engineering), and developmental testing and evaluation, in the fields of radiating or influence fusing; electrical, electronic, delay, or fluid time fusing, selecting command fusing, and pure fluid systems — either as project manager or in support of other AMC elements managing such projects.

(2) Perform related studies of means of optimizing weapon effects through fusing: of target signatures; of the effects of countermeasures, battlefield, nuclear, high altitude, and space environments on system performance; and of means of providing the maximum practicable immunity to such environmental effects as are ascertainable.

(3) Perform related research and development on instrumentation, measurement, and simulation, and on materials, components, subsystems including power supplies, transducers, and control systems.

(4) Perform weapon system syntheses and analyses.

(5) Conduct basic research in the physical sciences, and developmental engineering and testing, as directed by the Director of Research and Development, AMC.

If we now turn to the job descriptions of two typical Electronic Engineers (General) at this same laboratory, we will again fail to discover any requirement to include economic considerations. The word "evaluate" is used once or twice, but the personnel department of the laboratory has indicated that in the context in which the word is used, only technical evaluation is expected, not economic or cost-effectiveness evaluation.

We can now see the problems developing. Many so-called engineers are following the new "trend" mentioned by the Minnesota people and are not really practicing engineering. They have left out the economic aspect. And technical performance without economics — or vice versa — is no more engineering than pure sodium or pure chlorine is palatable table salt. (To stretch the analogy to its full extent, note that any significant quantity of either sodium or chlorine, taken separately, would be fatal.) But the orthodox engineer gives economic consideration to what he does — as a matter of course.

Entire organizations sometimes treat engineering the same as individuals do. Some Army Laboratories claim — or admit — that they do not practice engineering at all, let alone Value Engineering. Some assert that whatever Value Engineering they do is an inherent part of their engineering itself, and they have neither the time nor the inclination to separate it and report it.

Summary

Some of our problems have now been focused upon, exposed, and developed. Two more steps in this photographic analogy are necessary: printing and fixing. The printing, or summarization, of these problems follows:

1. The Department of Defense definition of VE is obscure. There appears to be acknowledged VE which is not reportable. Whether OSD will or will not acknowledge that all engineering must be Value Engineering is not clear. Nor is it really understood — at least, it is not thoroughly publicized — that the OSD will accept as Value Engineering a great deal of Value Analysis which is clearly not engineering.

The OSD has introduced subjectivity and personality into what should be an abstract, objective matter. The engineering decision itself is not accepted as paramount — e.g., whether or not it saves money without degrading quality, etc.; rather, the act must be performed only while the high-priest-engineer is wearing the proper vestments and saying the proper words. Further, all this can take place only if he has been properly ordained. By contrast, according to ASPR, the contractor automatically enjoys a higher-priestly status, once his act is blessed by the mere "offering" itself, without benefit of benediction.

2. The following questions remain to be answered:

a. Is production engineering sometimes Value Engi-

* Emphasis added

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neering?

b. Can production engineering ever not be Value Engineering?

c. Can any engineering not be Value Engineering?

3. To the engineer and the taxpayer alike, it is of little concern under what action-title economies are achieved. Engineers (as well as others who, it is hoped, will generate VE savings) are expected to exercise their economy-achieving abilities in the course of participating in decisions on concept, systems analysis, program definition, quantitative and qualitative requirements, initial design, initial test instrumentation and procedures, decision to redesign, decisions as to whether or not to rebuild and/or scrap old material, and improvement of existing designs. But to the office which records “Cost Reduction Program Accomplishments,” none of these actions except the last one is reportable. The pressure is thus on the engineer to devote his time to the “improvement of existing designs.” This leads to the complaint often voiced by engineers that this policy is tantamount to an invitation not only to produce careless designs in order to leave the door open for later improvement, with its concomitant recognition and award, but also to neglect their other duties.

The Effects on the Laboratories

It can be observed that these problems are far from being confined to Army Laboratories; but they are the problems that have the greatest effect on performance in the VE program. Large-scale production organizations, such as the U.S. Army Munitions Command or the U.S. Army Missile Command, can report multimillion-dollar savings without having to be concerned with such problems. They can establish creditable records of VE performance through their contractors' contributions alone. The few million more dollars that they might claim through including their laboratory-like actions could seem to them relatively insignificant.

But it is actual, not relative, performance that is meaningful here. Even one million dollars is of great importance to the taxpayer, to the Congress, and to the President. It has been stated emphatically and frequently that cost reduction is everybody’s business. Individuals with ideas that may be worth thousands, hundreds of thousands, or millions of dollars are easily discouraged from achieving and reporting their savings when they see the contribution of entire laboratories — sometimes to the tune of tens of millions of dollars — being brushed aside.

Some Recommendations

How can the situation resulting from these problems be “fixed”? (Here I must amend the photographic metaphor used earlier, in which it was suggested that the processes of focusing, developing, and so on, would lead up to “fixing.” Photographically, “fixing” is the process of bringing the development to a halt, of arresting it at a given stage. What I had in mind, however, was another use of the word “fix”: that of “repair” or “correct.”)

The achievement and reporting of VE savings by the Army Laboratories can be greatly facilitated if the following measures are taken:

1. Treatment of VE in terms of objective, impersonal results rather than in terms of the manner in which the results are achieved.

2. Establishment of a policy under which savings actions initiated in-house are as eligible to be called Value Engineering as the same actions are when proposed by a contractor. It costs the government far less to acknowledge as VE and to report a savings resulting from an in-house initiated action than it does to acknowledge and report a contractor-initiated savings, since most contracts contain clauses awarding the contractor approximately 50 percent of the savings he generates. Government employees, on the other hand — and in only a few cases at that — get only 2 or 3 percent of the savings they generate; and to receive even this tiny amount they must be nominated for it by their supervisors, and the award must then be approved by a number of successively higher echelons, depending on the dollar amount. Yet, despite the far lower cost to the government, the Army Laboratories' submissions that they have performed some Value Engineering are challenged, audited, reviewed, and screened much more severely than are similar claims by contractors.

3. Acceptance by the DoD Value Engineering and Cost Reduction Programs as “accomplishments” of all savings actions that meet the above-quoted requirements, whether such actions be termed Value Engineering, Eliminating Goldplating, or Value Analysis — and heaven forbid this togetherness being divided by auditors or other well-meaning people into three somewhat different terms, with the demand that actions conform to all three in order to be acknowledged.

4. Definition of VE in line with that given in the OSD pamphlet, Reduce Costs and Improve Equipment Through Value Engineering, quoted earlier. And let it be made clear that the actions given as factors warranting “account for” successful VE studies are in themselves VE. Let all engineering decisions be examined solely on their technical merits to see if they really are VE, even in cases where the authors themselves labeled them Production Engineering or Normal Duty or Fortuitous Discovery or Spontaneous Invention, and so forth. (A baby boy is a baby boy, even if some nearsighted old maid peers into his carriage and exclaims, “Oh, what a beautiful little girl!”)

5. Retreat from the position that Value Engineering and “normal performance” are dichotomous. Let it be admitted — and even insisted upon — that all engineers' actions are expected to be properly value/function-oriented. In turn, when engineers do perform in a value/function-oriented manner, let their contributions to the economic welfare of the country be suitably acknowledged in the VE and Cost Reduction Programs. This entails judgment of the output of the laboratories, as well as of the individual engineers, not on the basis of what they do or hold above what they are expected to do, but rather on the basis of what they do that would not be done at all without them.

For example, how much further do we advance the state of the art of proximity fuzes by maintaining the Harry Diamond Laboratories in existence? Could we do without this organization and still demand, the quality, reliability, performance, and on-time delivery of our needed fuzes? Is this laboratory worthwhile? If it is, then the (VE) measure of its value is the summation of the value of the individual contributions of its engineers. Since the whole is equal to the sum of all its parts, we can logically conclude that no laboratory is better than the effective sum of its people — or the sum of its effective people! The converse must then hold, too. For a laboratory to be outstanding, there must be outstanding individuals in it, making outstanding contributions. See what has happened however. The Cost Reduction Program guidance emanating from OSD, has no provision under which the Army is able to acknowledge any significant portion of its laboratories' performance as contributing to improvement in our national economy. How discouraging!
Most of our discussion has centered on Value Engineering. It can and should be applied to non-hardware — from the engineering point of view — i.e., how to get engineering savings exists in the analysis aspect of this technique, which is as much a management technique as it is engineering. It can and should be applied to non-engineering Value Analysis should be sought equally as diligently as those resulting from technical change.

The Problem of Measurement

Finally, as frequently happens, we find that the solutions proposed for our original problems have uncovered another which had been considered somewhat irrelevant. As long as we refused to recognize the input of Value Engineering to original design work and to the program definition and conceptual phases, the measurement of this input posed no problem. But, if we do allow it, how do we go about measuring it?

For the VE program, what we want is the ability to measure and report all savings arrived at through the laboratories' generation of new designs which keep abreast, and even ahead, of the state of the art. In the simplest case of this sort, a previous design would be used to establish a "before" unit cost; but the original design, rather than being subjected to alteration, would be relegated to obsolescence, and a completely new design would be evolved. The apparent, or gross, savings would then be computed by multiplying the difference between the "before" and the "after" unit costs by the applicable production quantity. (Unit costs should, of course, include logistic support costs.) From this gross figure we would then have to subtract the entire cost of the research, development, test, evaluation, and tooling required by the new design. At first sight this might seem to be a harsh requirement; but, if the old design actually worked properly and could have been developed, produced, and supported at a lower cost than the new one, it should have been retained. (Let us hope that only rarely is a new design adopted when it is not significantly better in overall cost effectiveness than the old one; but in such a case, certainly there are no savings.)

A greater difficulty arises in measuring savings generated by applying VE in the early stages when there is no previous design at all. A solution in this case is found through resorting to a statistical treatment. No matter how much we would like it to be otherwise, there will always be a large number of cases in which cost/value considerations have not been applied the first time around. We can apply VE to a sample number of these, generating not only savings but also a useful statistical factor. The factor to be obtained is the probable savings (expressed as a percentage of the item cost) which can be evoked by various intensities of VE effort. Thereafter, in accordance with the intensity of VE effort which the original designers put into their work, final costs can be multiplied by the appropriate factor, and the probable amount of savings computed. Such a probabilistic figure could not be applied to individual performance, since the nature of this multiplier would be such that half the individuals concerned would be generating savings greater than the factor would indicate, and the other half would be generating smaller amounts of savings. For a large organizational unit such as a laboratory, however, such an average can be used to express its over-all output.

The validity of the factors can be checked whenever further VE studies are made on the same items. Successively applied VE studies would normally be capable of generating successively smaller and smaller savings until the cost/worth ratio reached its perfection point, unity. Unusually high or low percentage savings achieved on the second, third, and subsequent formal studies would indicate that the original factors were correspondingly too high or too low, and adjustments could be made.

In computing and checking these factors, the gross second and third time savings (i.e., excluding retooling costs) should be used, because we are looking for the amount of the benefit that would have occurred had these savings actions been instituted in the first place, with only one set of tools being required.

Conclusion

We have now completed our task. We have identified problems which militate against the ability of Army Laboratories to achieve, measure, and report their full VE potential. We have proposed solutions to those primary problems; we have identified a secondary problem thus generated; and we have proposed solutions to that, too.

Let us not overlook the purpose for which this was done. You who represent the big production organizations should not disdain the potential savings from your laboratory-like operations, and you are urged to join the representatives from the laboratories in asking that these solutions be favorably considered. If they are adopted, several million dollars of VE savings can be recognized and reported throughout DoD.

It is you, the OSD officials, however, who must respond to our pleas. It is you, Mr. Fouch; it is you, Mr. Morris; and it is you, Mr. McNamara, who must decide to accept these solutions or to provide us with better ones in order that the Value Engineering and the Cost Reduction Programs may approach more nearly their full potential.

References


13. Ibid., pp. 6-7.


15. Dept. of the Army, Defense Cost Reduction Program, Inclosure 2, "I.C. Eliminating Goldplating (Value Engineering)"


18. Ibid., "Policy" (b).


22. Personal interview with Mr. R. G. Thresher, Chief, Materials Readiness Directorate, Limited Warfare Laboratory.
This paper examines the function of worth and the way that worth can be used most profitably: an orientation for cost. The magnitude of the cost saving available from this orientation is directly proportional to the use of worth as a baseline from which to build. It is this decision that determines whether a cost solution will be directed toward a maximum or a minimum dollar potential.

This paper is offered as food for thought to both practitioners of value engineering and to those who are merely observers, albeit interested observers.

Value engineering is a problem solving methodology oriented to cost. Tracing the use of the value techniques upstream toward the source provides an understanding of the concept itself; this is the key to achieving the goal of maximum cost avoidance and saving. Directing attention from HOW a technique is used toward WHY it is used lends a different dimension to its use.

One important technique of value engineering is WORTH — function worth. An understanding of the technique of function worth requires an upstream look at what the function of worth is, and why.

This paper provides visibility for cost by focusing attention on:

- What worth does
- What worth can do
- Why
to establish its place in the value engineering scheme of reducing cost.

Worth in Perspective

Function worth is the least expensive way of performing a function with complete disregard for application, because a function is dimensionless. Function worth is also one-half of the comparison used to establish value; the other half of the comparison is cost.

"How" (or secondary) functions are, by definition, worth nothing in the value engineering world of cost. Interestingly enough, "how" is where the majority of the published — or spoken — word begins: How to determine the worth of a function. This "how" state leads to the solution conscious habit, and consequently, there is a tendency to assume "how to" will automatically lead us to our goal. Unfortunately, the basis for how to do it in the future is seldom expanded beyond how it was done in the past. Because of this status quo condition, a cost problem that exists today continues to exist when today becomes the day before yesterday.

The Function

Value engineering practitioners tend to agree that worth is used to provide orientation for both speculation and cost. The function of worth then, is to PROVIDE REFERENCE: this is what worth does. This function can be understood best by comparing the limitations of the how potential of worth with the advantages of the maximum potential for worth.

Improving and correcting the present system is the most common use of worth; it is thought of as a "reasonable" price to perform a function. This is the how potential of worth.

The maximum potential for worth occurs at some infinite goal. At that point, the worth orientation becomes one which: 1) conditions mental attitudes toward an ideal ap-
The Maximum Potential for Worth

Sharpening the Focus

The name of the value engineering game is dollars. Focusing on the function of worth requires understanding that the causes of cost are the parameters of performance and delivery. Extending this rationale, each ultimate solution will contain a balance of all three parameters: cost, performance, and delivery.

The how potential for worth can best be illustrated by describing a typical problem-solving sequence involving a system or approach in which a cost problem has been identified. The cost of the present system or approach is represented in Figure 1 as \( C_p \), the present approach cost. The need to reduce or avoid cost has been recognized and a decision has been made that the cost must not exceed some maximum dollar level, \( C_t \), the target cost. A target baseline has now been established consistent with the cost of the present system. Attacking the present cost locks in the present approach, and limits change in cost to those results that can be achieved through modifying how the present system is mechanized. These modifications lead down the diagonal cost path of Figure 1.

As the target cost, \( C_t \), is approached, performance and delivery requirements manifest themselves, additional costs are incurred to meet these requirements, and some of the anticipated savings are lost. The probable resultant cost, \( C_{rh} \), is below the present cost, but is some increment of cost, \( \Delta_{ic} \), above the maximum cost level \( C_t \). The dollar magnitude of \( \Delta_{iw} \) is the portion of the original cost problem that remains.

The maximum potential for worth can now be developed and is illustrated in Figure 2. The same initial posture exists: a cost problem has been identified; the present approach cost is \( C_p \); and a target cost, \( C_t \), has been assigned based on a need to reduce or avoid cost. Worth is used to its maximum advantage as an optimum cost target for the function(s) needed. This drives the potential cost down to an extremely low point because we are no longer concerned with the restraints imposed by the mechanical execution of the present system and the costs associated with the how, or secondary, functions of that system. The limitations on the potential for other solutions have been removed and we need only consider the "what" functional requirements and their associated costs. The lowest potential cost, or worth, is identified as \( W \), the cost of the ideal approach. The final solution for cost must still meet basic system requirements, however, we now have the flexibility to start at worth as an ideal and build a system by adding the elements necessary to meet the parameters of performance and delivery. Each of these elements add cost, and the probable resultant cost will become \( C_{rw} \), the cost of the approach utilizing worth as a base. \( C_{rw} \) will be at some increment of cost \( \Delta_{iw} \) above worth and below \( C_t \), the target cost.

Worth, used as a dollar reference for functions, has the potential to identify maximum cost avoidance/cost savings. This is what worth can do and is illustrated in Figures 3 and 4.

Figure 3 illustrates the increment of cost, \( \Delta_C \), that can be avoided by using function worth as a baseline:

\[
\Delta_C = \Delta_{iw} + (C_t - C_{rw})
\]

Figure 4 identifies the dollar reduction (savings) that can be achieved by using function worth as a reference for cost problem solution.
Summary
The function of worth is to provide a reference for cost. Worth can be used to obtain a lowest cost problem solution. Fundamental to the development of this potential is the recognition that a choice must be made between a "reasonable" target to shoot for and a psychological target to build from.

An upstream look at worth requires that the restraints of convention be replaced with a new dimension for cost. The new dimension for cost is why function worth should be used.

Bibliography
2) Gerald Nadler, Work Design, Irwin, Inc., 1963 (This infinite goal is similar to what Nadler identifies as a theoretical ideal system in work systems.)

Definition Of Terms
Present System or Approach — Any of the following, with equal applicability to hardware, software, or organizational element:
- The existing system or part of that system
- An approach which has been developed but not yet implemented
- A concept developed only to the approach stage

Performance — That which pertains to the development of the operating requirements of the system.

Delivery — That which pertains to the execution of the operating requirements of the system.

Glossary of Symbols
\[ C_p \] Cost of the present system or approach
\[ C_t \] Target cost or baseline
\[ C_{rh} \] Probable cost level from modifying the present system or approach
\[ C_{rw} \] Probable cost level from using function worth as a baseline
\[ \Delta_{hc} \] Cost difference between \( C_{rh} \) and \( C_t \)
\[ \Delta_{iw} \] Cost difference between \( C_{rw} \) and \( W \)
\[ \Delta \alpha \] Cost difference between \( C_{rh} \) and \( C_{rw} \)

Miscellaneous Notes
This is the first issue of the Journal since discontinuance of its publication in 1965. An attempt was made to select from the articles submitted those which reflected on the present status of Value Engineering.

The October issue will focus on the horizons of Value Engineering by exploring the "Untapped Potentials", a theme taken from a paper by Boyd R. Dixon. In his talk at the national convention, George Fofch exposed an area where VE needs to be applied in what he calls Indirect Work Capability. Taxonomically speaking, Bert Decker wants to value engineer progress or "Poverty Provides No Profit." Several other articles will explore the fringes of value engineering, particularly on how VE interfaces with other disciplines.

There has been a steady flow of papers which are being considered for future issues. Most of the papers exceed the 2,000 word limit. In order to provide the opportunity for expression by more members of the Society, efforts will be made to adhere strictly to the parameters established on the inside cover of this issue.

For persons who would like to contribute papers but perhaps lack ideas, we need more articles on techniques and methodology. It has been alleged that VE is past the embryonic stage and, if so, most practitioners will have developed their own techniques. Exposing them, as Bob Thorshiem has done in this issue, meets the purposes of the society. An interesting article might be done on the definition and classification of functions. For example, the worth of some functions is determined by the cost of the hardware solutions, the worth of other functions is determined by the external environment — in terms of damage prevented, payload delivered, etc. The kind of function being considered varies as the phase of the program. Additional knowledge, useful to value engineering, might be attained by structuring and classifying functions and noting how the worth is determined.
The Relationship of Value Engineering and Configuration Management

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Definitions

"Value Engineering" as defined by Department of Defense Instruction 5010-8, and Air Force Regulation 70-16, "is an organized effort directed at analyzing the function of systems, equipment and supplies for the purpose of achieving the required function at the lowest overall cost, consistent with requirements for performance, reliability and maintainability." In essence, VE deals with ideas — ideas to improve cost effectiveness. Ideas have little value until they are introduced or "sold" to someone that will benefit from their application. Value Engineering ideas are sold through the medium of the discipline called Configuration Management. Thus in order to maximize their effectiveness, Value Engineers must understand the principles and operation of this related discipline. Of particular benefit is the understanding of the timing of various types of changes and information required to optimize the acceptance rate of VE changes.

"Configuration Management" as defined by AFSCM 375-1, "is the management of technical requirements which define systems, system equipment, or individual changes thereto." It consists of three elements — configuration identification, configuration control, and configuration accounting. Configuration identification is the technical documentation defining the approved configuration of systems/equipment under development, test, and production. The approved configuration is the one which the Government has defined, and for our purposes, has on contract at the particular point in time. Thus, it is apparent that the approved configuration is a variable, that change is inevitable and to be expected. Configuration control is the systematic evaluation, coordination, approval and/or disapproval of all changes to a baseline configuration. Configuration accounting is the act of reporting and documenting changes made to a baseline configuration in order to establish a configuration status.

The baseline configuration plus accepted Engineering Change Proposals (ECPs) identify the system in much the same manner as a drawing, plus approved Engineering Orders (EOs) identify a fabricated part or assembly. From the preceding definitions one can readily see that Configuration Management is essentially Baseline Management or management relative to a number of baselines. There are three baselines involved in Configuration Management. These are the Program Requirements Baseline, the Design Requirements Baseline, and the Product Configuration Baseline. Each will be covered in greater detail.

A primary premise of the baseline concept is that there must be a recognized and documented initial statement of requirements and that once stated, any change in requirements will be documented so that the current status of a program may be fairly judged in terms of conformance to requirements. A VE change, like any other type of change, must make use of the baseline concept as a departure point for a new idea. A VECP, to be acceptable, must be a more cost effective solution than that specified in the baseline requirements.

Now let us examine the various baselines encountered in the life cycle of a system. The time period immediately preceding the establishment of the Program Requirements Baseline is the domain of Systems Engineering type activity. It is during this stage, the Conceptual Phase, that functional requirements are determined, system performance and design requirements are established and trade-off studies are identified and performed. While there is some similarity of this effort to Value Engineering, it is not VE in its strictest sense. The personnel involved are generally not trained in the skills of Value Engineering. While they do have an interest in cost effectiveness, they are "requirements oriented" rather than "value oriented."

Program Requirements Baseline

The first baseline is the Program Requirements Baseline. It is technically defined by a system specification which is initially issued by the customer at the start of the definition phase, and is complete to the extent necessary to specify the initial system performance requirements. One system specification is prepared for each system series. Included in the systems specification are:

1. The performance and design requirements for the system.
2. The performance requirements relating to manning, operating, maintaining andlogistically supporting the system, to the extent these requirements define or constrain design of system equipment.
3. The design constraints and standards necessary to assure compatibility of system hardware.
4. The principal interfaces between the system being specified and other systems with which it must be compatible.
5. The system segments of the system and the principal interfaces between and within system segments.
6. The allocation of performance to and the specific
design constraints peculiar to each system segment.

7. The identification and relationship of Contract End Items (CEIs) which comprise the system.

8. The identification and use of major Government-furnished property to be designed into and redelivered with system equipment or to be used with other system equipment as an entity or an integral part of system capability.

Theoretically, it is from the Program Requirements Baseline that Value Engineering Changes could be generated. However, since in the normal sequence of events, a contract has not been issued, any VE changes must be developed as in-house Government effort. The functional requirements, performance and design requirements and trade-off studies are further defined during this period, by the System Program Office (SPO), which came into existence at the beginning of the Definition Phase. Government VE personnel can begin their contribution to system cost effectiveness during this time period. One of the ways is by a review of the Statement of Work (SOW) which is to be included in the Request for Proposal (RFP). A factor to be reviewed is the overall cost effectiveness of the requirements contained in the SOW. The primary questions would be:

1. Have the prospective contractors been unnecessarily restricted by specifying the "how" rather than "what" is required?

2. Do all elements appear to be "required" rather than merely "desirable"?

Such a review is particularly applicable to the DD Form 1423, "Contractor Data Requirements List" contained in the Statement of Work. If data is desired by the procuring agency it must be specifically listed in the contract on a DD Form 1423. Only when data is so listed, can a contractor be assured of payment for furnishing the data. But duplicative and unessential data requirements can still find their way onto the Data Requirements List. A VE review can highlight them and cause their removal.

Another contribution of VE relates to whether the contract sufficiently defines the hardware being procured. This review is particularly appropriate to follow-on procurements relating to a new system series. Generally when a new system series is procured, a large percentage of the components will be identical to the previous series or merely modified to support the interface considerations of revised components. Failure to specifically identify the system elements which do not require change in the updated series would preclude the contractor from effectively applying Value Engineering. This is based on the fact that any VECP submitted would be disapproved as not requiring a contract change to implement.

Immediately after receipt of a contract, and during the balance of the definition, a contractor may begin the submission of changes to the Systems Specification which was produced by the Government or under the direction of the Government. The earlier that VE ideas are developed and submitted, the greater the potential savings. Early submission and approval obviously allows application of the idea to the greatest number of units.

Design Requirements Baseline

The second baseline is the Design Requirements Baseline which marks the end of the definition phase and the beginning of the acquisition phase. It is technically defined by Part I of the Contract End Item Detail Specification (CEI Spec). The CEI Spec is composed of two parts, each of which have distinct and different uses in the contractual control of Contract End Item acquisition. Each of the two parts is complete in content and format with respect to its intended use. The CEI Spec is controlled and accounted as an entity, using a single end item configuration chart and a single specification change log. Part I is a product of a program definition phase or requirements analysis and is the technical requirements document used to contract for design and development of the CEI. Part II will be discussed in connection with the Product Configuration Baseline. Contractor compliance with Part I is determined by evaluation of qualification, reliability and other test records. From the point of the design requirements baseline, configuration control is accomplished at contract end item level. During this initial segment of the acquisition phase, design, development and test occurs and the contractor can prepare design requirements changes challenging design, development or test requirements, which are specified by contract, either directly or by reference. The fact that the contractor originated or participated in the origination of such requirement does not in itself prevent a contractor-originated change which reduces overall cost from qualification as a valid VECP. The proper formal review occurs during this time period, which can be used to increase the effectiveness of both contractor and Governmental VE programs. This assumes, of course, that VE personnel are notified precisely when these reviews will occur. The first of these reviews is the Preliminary Design Review (PDR). It occurs just prior to the start of detail design effort. The PDR is a formal technical review of the basic design approach for Contract End Item(s). The PDR assures that (1) design and test requirements are valid, (2) the design and test approach representing the design solution is acceptable, and (3) functional interfaces between end items have been identified. AFSCM 375-1 states that one of the facets of the review that must be accomplished as part of each PDR is "the parts of the design to be subjected to detailed value engineering analysis shall be identified and a completion date for value engineering analysis established."

The other formal review, the Critical Design Review (CDR) occurs at the completion of the detail effort and prior to committing the item to production. This is the point in time by which the detailed value analyses identified at the PDR should be completed. The CDR formally establishes the design as a basis for supporting activities, e.g., preparation of provisioning documentation, preparation of technical manuals, actual provisioning of initial spares, etc.

Product Configuration Baseline

The third baseline is the Product Configuration Baseline. It is technically defined by Part II of the CEI Spec. Part II is a product of the design and development contract. It specifies the Contract End Item (CEI) in terms of the detail product configuration requirements of the item qualified under the terms and conditions of the design and development contract.

Formal acceptance of Part II of the spec by the procuring agency occurs at a formal technical review called a First Article Configuration Inspection (FACI). During the FACI, the audit is accomplished by establishing the exact relationship of the CEI as described by released engineering data to the CEI, which was manufactured and assembled to the released engineering data. The FACI also establishes the exact relationship between the configuration of the CEI identified for production and the configuration of the CEI qualified or to be qualified. The FACI establishes the validity of the acceptance test methods and test data with the specified performance of of the Society of American Value Engineers JULY, 1968 • 17
the CEI which is to be delivered. AFSCM 375-1 states that by mutual agreement of the procuring agency and the contractor, the FACI of several CEIs may be accomplished at a single FACI. Since 20 to 30 personnel may be involved in this one-to-three day exercise, such provisions for minimizing travel costs and the hours that contractor personnel are kept from their primary assignments contribute to the cost effectiveness attitude of both contractor and Government personnel associated with a specific system. The FACI is another one of the ideal points during the acquisition cycle when an overall cost effectiveness review of the system may be made by Government and contractor personnel without great difficulty. The hardware and all released engineering data on the CEIs being reviewed are assembled in one place. The additional introduction of process information (the manufacturing processes to be used by the contractor in the fabrication of the CEIs) and cost information (unit cost by CEI), would permit greater use of VE techniques by participating Government and contractor personnel.

During the production period which completes the remainder of the acquisition phase, the contractor can prepare product configuration changes as outlined in ANA Bulletin 445, and as supplemented by detailed direction issued by the specific system involved. Normally, such changes are submitted in the same manner as an ECP. The basic difference being the addition of a "V" prefix and the inclusion of more detailed cost information.

Although this paper has primarily discussed engineering or hardware changes covered by ANA Bulletin 445, many opportunities for submission of VE changes on "software" also exist. Care should be exercised on software submissions to assure that the requirements of the VE contract clause are met. Specifically, software changes (as well as hardware changes) to qualify as "Value Changes" must require a change to the contract.

In conclusion, the acceptance rate of both contractor and Government originated value changes on hardware or software can be improved by understanding the principles and operation of the methodology called Configuration Management.

REFERENCES:


Parameters for Articles

LENGTH: 1500/2000 words (6 to 8 typewritten pages, double spaced, with art)

ART: Camera ready or glossy prints

AUTHOR: must furnish clearance for publication from his organization, a brief résumé in 75-100 words, an information abstract in less than 200 words, a self photograph (3x5 glossy print), and a COMPLETE RETURN ADDRESS AND TELEPHONE NUMBER.

SUBJECT: Should be reoriented or related and should contribute to the continued development of VE

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