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VALUE ENGINEERING

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FOREWORD

Value Engineering (VE)

VE is recognized as an effective technique for reducing costs, increasing productivity, and improving quality-related features such as durability, reliability, and maintainability. There has been a VE program in the Department of Defense (DoD) for over twenty years. Then, as now, the DoD VE program consists of in-house and contractor activities. Provisions in the Federal Acquisition Regulation permit a contractor to share the savings that result from those contractor value engineering change proposals that are accepted by the Government.

The first in this handbook series, DoD Handbook 111, was published on March 29, 1963. Since its second publication in 1968, as DoD Value Engineering Handbook, DoD 5010.8-H, portions have again become obsolete. The integration of VE with design to cost, acquisition streamlining, spares value analysis, and other recent management initiatives along with the emphasis on VE as an integral part of the line management process are some of the reasons that prompted this revision. This Handbook is authorized by DoD Directive 4245.8.

This Handbook is intended as a guide and should not be interpreted as a DoD directive. It is intended to provide an understanding of the DoD VE program in order to encourage broad participation and achieve maximum benefits. It has been prepared by the U.S. Army Management Engineering Training Activity (AMETA). However, some material in the Handbook has been synthesized from extensive comments and suggestions received from both Government and industry contributors. Suggestions for further improvement should be addressed to the Office of the Assistant Secretary of Defense (Acquisition and Logistics), Pentagon, Washington, D.C. 20301-8000.

DoD Components may obtain copies of this publication through their own publication channels. Other Federal Agencies and the public may obtain copies from the U.S. Department of Commerce, National Technical Information Services, 5285 Port Royal Rd., Springfield, Virginia 22161.

James P. Wade, Jr.
Assistant Secretary of Defense
(Acquisition and Logistics)

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C1. CHAPTER 1

PERSPECTIVE OF VALUE ENGINEERING (VE)

C1.1. INTRODUCTION

C1.1.1. The amount of money available for our country's defense is determined by the democratic processes by which we govern ourselves. Defense budgets are affected by the threat from our adversaries, our reaction to the threat, by the funds necessary for Government activities other than defense and finally by our skill in managing the resources entrusted to us for defense. Efficient utilization of these allotted resources has been a major management objective for many years. The quickening pace of technological advances and the increasing pressure of budgetary restraints have made it necessary to place even more emphasis on economy and efficiency within the Department of Defense (DoD).

C1.1.2. DoD policy is to use VE to make a significant contribution toward greater economy in developing, acquiring, operating, and supporting the products necessary to fulfill its mission. The DoD VE program is intended to foster the use of value-oriented techniques across the entire spectrum of DoD activities.

C1.1.3. VE is a fundamental approach which challenges everything and takes nothing for granted, including the necessity for a product or service. It is applicable to systems, equipment, facilities, procedures, methods, software, and supplies. It may be successfully introduced at any point in the life cycle of the product under consideration (see Chapter 2). The following are some of the areas in which VE has been applied in the Department of Defense:

C1.1.3.1. Construction.

C1.1.3.2. Design or equipment modifications.

C1.1.3.3. Equipment and logistics support.

C1.1.3.4. Equipment maintenance.

C1.1.3.5. Facilities, master plan, and concepts.

C1.1.3.6. Hardware.

C1.1.3.7. Manufacturing processes.

C1.1.3.8. Material handling and transportation.

C1.1.3.9. Packaging, packing, and preservation.

C1.1.3.10. Procedures and reports.

C1.1.3.11. Procurement and reprocurement.

C1.1.3.12. Publications and manuals.

C1.1.3.13. Quality assurance and reliability.

C1.1.3.14. Salvage, rejected, or excess material.

C1.1.3.15. Site preparation and adaptation.

C1.1.3.16. Software (computer) programs and flow charts.

C1.1.3.17. Specifications and drawings.

C1.1.3.18. Technical and logistics data.

C1.1.3.19. Technical requirements.

C1.1.3.20. Testing, test equipment, and procedures.

C1.1.3.21. Tooling.

C1.1.3.22. Training.

C1.1.4. VE emerged from the industrial community. It has spread throughout private industry and within the Department of Defense because of its ability to yield a large return on a relatively modest investment. It is an additional management tool to gain the desired results within the constraints of time and cost. To realize this potential, VE must be clearly understood and correctly applied. This Chapter provides the perspective for the VE program in the Department of Defense.

C1.2. HISTORICAL BACKGROUND

C1.2.1. The VE concept is a by-product of material shortages during World War II. These shortages led to the creation of innovative material and design alternatives. It

was found that the alternative approaches often worked as well, or better, and cost less. From this beginning an analytical discipline evolved in private industry that was structured to challenge the proposed way of designing and acquiring things and to systematically search for less costly alternatives.

C1.2.2. In 1957, the Navy's Bureau of Ships became the first DoD activity to establish a formal VE activity. It was called "value engineering" because it was staffed with general engineers, the most closely related position description available at that time. Although no longer exclusively the province of "engineers," the term "value engineering" has persisted as the title of the program.

C1.2.3. The Department of Defense established its VE program in 1963. It continues to have two distinct elements. The first is an in-house effort whereby VE is performed by DoD military and civilian personnel. The second is the program that was created to stimulate contractors to perform VE and to develop and submit value engineering change proposals (VECPs). Accepted VECPs change contract specifications, purchase descriptions, or statements of work that impose costly, nonessential requirements. An incentive is provided by giving the contractor a share in the savings that result from any approved change proposals submitted by the contractor and approved by the Government. An alternative, the program requirement clause, is used to pay a contractor for VE activities regardless of whether the purpose is submission of VECPs or some other cost reduction purpose.

C1.2.4. With some few exceptions, it has been mandatory since June 1962 that VE provisions be included in most DoD contracts to encourage contractor participation and to realize the full benefits from cost reduction opportunities and innovations.

C1.2.5. Prior to the development of the clause permitting contractors to share in the savings, a contractor who submitted a cost reduction change had the amount of his contract reduced by the total reduction. This usually reduced his profit by a proportional amount. There was, therefore, no incentive to submit proposals to reduce cost. Now the VE clause allows a portion of the saving accruing to the Government to be returned to the contractor.

C1.2.6. Unfortunately, there are still some Government personnel who believe that the contractor is paid twice or is unjustly rewarded. A close examination of the clauses, an understanding of the safeguards in the acquisition process, and some familiarization with the reasons for unnecessary costs should serve to correct this erroneous idea.

C1.3. VE DEFINED

C1.3.1. In the Department of Defense, VE is defined as a systematic effort directed at analyzing the functional requirements of DoD systems, equipment, facilities, procedures, and supplies for the purpose of achieving the essential functions at the lowest total cost, consistent with the needed performance, safety, reliability, quality, and maintainability. Although there are numerous other published definitions of VE, most are merely minor variations of this definition. Value Engineering (VE) is the term used in this Handbook and by the Department of Defense in its contracts. Terms such as value analysis, value management, value control, and others are considered synonymous. Some use them to differentiate the use of the value process by those who are not engineers. Thus, value analysis is sometimes used to describe a value program in a purchasing or acquisition function. The terms value control or value management are used by some to describe the application of value techniques to administrative and office procedures. There may be some subtle differences among these terms but the basic objectives and philosophy appear to be the same for all. The DoD VE program encompasses all value-oriented activities.

C1.3.2. VE is not centered on a specific category of the physical sciences. It incorporates available technologies as well as the principles of economics and business management into a specific procedure. Chapter 5 of this Handbook describes the generation of value proposals portion of this procedure. Marketing of value proposals is one of the most difficult segments of the VE process. Chapter 6 of this Handbook is devoted solely to this topic.

C1.3.3. VE utilizes the total resources available to an organization to achieve broad, top management objectives. Thus, VE is seen as a systematic and creative approach for increasing the "return on investment" (ROI) in components, weapon systems, facilities, and other products acquired and operated by the Department of Defense.

C1.3.4. Increased ROI for the Department of Defense results from a combination of lower costs for acquisition, logistics, or operation while maintaining the necessary level of performance. It often results in capability for the same or a lower dollar expenditure. This viewpoint is consistent with statements of policy and regulations governing VE in the Department of Defense, and serves to further describe the role of VE in the Department of Defense. For industry, the benefits of VE include an acceptable ROI, increased profits, and improved competitive position.

C1.4. PROGRAM OBJECTIVE

C1.4.1. The basic VE concept is that anything providing less than the performance required by the customer or user is not acceptable; anything providing more should be avoided unless there is no cost penalty.

C1.4.2. The objective of VE in defense contracting is to reduce the Government's acquisition or ownership costs (operational costs, maintenance costs, training costs, etc.) while maintaining the necessary level of performance. This objective may be achieved by encouraging contractors to respond to the VE clauses in DoD contracts. These clauses invite or require contractors to initiate, develop, and submit cost-reduction proposals during performance of a contract that involve changes to contract requirements. The clauses require the Government to share with the contractor any cost reduction resulting from a VECP. VE clauses in DoD contracts are not enough. The clauses merely permit contractors to question the value of Government specifications, statements of work, and those requirements that contribute nothing (except cost) to the contract tasks or items being bought. The invitation must be accepted by the Government. Then both parties (Government and contractor) must work together to capture the actual benefits.

C1.5. FUNDAMENTALS

C1.5.1. Function. Function is defined as the specific purpose or use intended for something. It describes what must be achieved. For VE studies, the description of function is reduced to the simplest accurate expression. This is accomplished by employing only two words; an active verb and quantifiable noun. "Support weight," "transmit torque," and "conduct current" are typical expressions of function. Note that each function is described in terms that are quantifiable and measurable.

C1.5.2. Worth. Worth is the least expenditure required to provide an essential function and is established by comparison. (One method of approximating worth is by determining the cost of a functional equivalent.) Worth is not affected by the consequence of failure. (For example, if a bolt supporting a wing of an aircraft fails, the plane may crash. Nevertheless, the worth of the bolt is the lowest cost necessary to provide a reliable fastening, not the cost of a downed aircraft.)

C1.5.3. Cost. Cost is the total amount of funds required to acquire, utilize, and maintain the specified functions. For the seller, this is the total expense associated with the production of a product. For the Department of Defense, the total cost

includes not only the purchase price of the product, but also the costs of introducing it into the DoD inventory, operating it, supporting it throughout its usable life and disposing of it when it no longer serves a useful, functional purpose. (Total cost also includes a proportionate share of the in-house expenditures for development, engineering, testing, spare parts, and various categories of overhead expense.)

C1.5.4. Value

C1.5.4.1. Value is the relationship of worth to cost in accordance with the user's (or customer's) needs and resources in a given situation. The ratio of worth to cost is the principal measure of value. Thus, a "value equation" may be used to derive a Value Index as follows:

$$\text{Value Index} = \frac{\text{Worth}}{\text{Cost}} = \frac{\text{Utility}}{\text{Cost}}$$

C1.5.4.2. Value may be increased by:

C1.5.4.2.1. Improving the utility of something with no change in cost;

C1.5.4.2.2. Retaining the same utility for less cost; or

C1.5.4.2.3. Combining improved utility with a decrease in cost. Optimum value is achieved when all utility criteria are met at the lowest overall cost. Although worth and cost can each be expressed in monetary units, value is a dimensionless expression of the relationship of these two.

C1.5.5. Types of VE Recommendations

C1.5.5.1. Within the defense environment there are two acronyms used for the recommendations resulting from VE efforts. They are:

C1.5.5.1.1. Value Engineering Proposal (VEP). A VE recommendation originating and implemented solely within the Government, one which was originated by a contractor and may be implemented as a unilateral contractor action (i.e., a Class II change), or one which was originated by a contractor hired solely for the purpose of doing VE and implemented by the Government.

C1.5.5.1.2. Value Engineering Change Proposal (VECP). A formal recommendation by a contractor requiring Government approval and that will require a change to the contract, specifications, purchase description, statement of work, etc., and result in a decrease in the overall cost to the Government. VECPs may be submitted by

contractors having a VE clause included in their contract in accordance with the applicable acquisition regulation. Subcontractors may also submit VECPs to prime contractors in accordance with the terms of their contract. The current acquisition regulation directs contractors to include VE provisions in subcontracts (with certain limited exceptions) of $100,000 or more. Spares contracts and subcontracts of $25,000 or more must include a VE incentive (VEI) clause. (See Chapter 3 for a more complete discussion of contractual aspects.)

C1.6. A TYPICAL VE PROGRAM

C1.6.1. A typical VE program is a defined set of policies and responsibilities that will ensure that VE discipline is integrated into all elements of an organization. An effective and sustained VE program will have:

C1.6.1.1. Top management involvement to ensure implementation and continuing emphasis by middle management.

C1.6.1.2. A key individual to manage the VE program. This individual should be well versed in VE principles, techniques, and appropriate acquisition regulations.

C1.6.1.3. A "master plan" to insure that actions that may effectively contribute to a sucessful program are considered and acted upon.

C1.6.1.4. VE objectives, policies, responsibilities, and reporting requirements firmly established and implemented.

C1.6.1.5. The funds necessary for administrative and operating expenses such as testing and evaluating proposals.

C1.6.1.6. A comprehensive training and orientation program, to acquaint personnel with policies, procedures, and benefits.

C1.6.1.7. "Cross-feed" mechanisms to communicate information about successful application to others who can benefit.

For defense industry programs, the following should also be included:

C1.6.1.8. Close coordination with contract administration and marketing to ensure proper VE contractual participation and marketing follow-up.

C1.6.1.9. Management attention to ensure that the VE discipline is used to earn additional income.

C1.6.2. Although there are many other specific tasks required to ensure that VE achieves its full potential, the above form the foundation upon which the structure of a strong program may be built.

C1.7. OPPORTUNITIES FOR VE

C1.7.1. Shortly after its program was established, the Department of Defense conducted a study to determine the predominant sources of the opportunity for VE. The objective of the study was to determine the range and degree of application of VE. With the combined assistance of the three Military Departments, the Defense Supply Agency (now the Defense Logistics Agency), and the Society of American Value Engineers a review was conducted of 415 implemented VE changes that yielded total cost savings of $106 million. This study identified seven factors that were responsible for about 95 percent of the savings. Predominant were excessive cost, additional design effort, advances in technology, and the questioning of specifications. It is important to note that these factors do not suggest that the original design efforts were substandard. The study also revealed that a single factor was rarely the basis for a VE action. The study findings are tabulated in Figure C1.F1., below.

Figure C1.F1. Factors Leading To VE Changes

Percent of total actions	Percent of total savings	Factor	Definition
13.9	23.2	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.
23.1	22.2	Excessive cost	Prior design proved technically adequate, but subsequent cost analysis revealed excessive cost.
14.4	17.7	Questioning specifications	User's specifications were examined, questioned, determined to be inappropriate, out-of-date, or overspecified.
27.8	14.8	Additional design effort	Application of additional skills, ideas, and information available but not utilized, during previous design effort.
5.2	11.8	Change in user's needs	User's modification or redefinition of mission, function, or application of item.
6.8	4.0	Feedback from test/use	Design modification based on user tests or field experience suggesting that specified parameters governing previous design exaggerated.
4.6	3.8	Design deficiencies	Prior design proved inadequate in use (e.g., was characterized by inadequate performance, excessive failure rates, or technical deficiency).
4.2	2.5	Miscellaneous	Other factors not included in above.

C1.8. BENEFITS OF VE

C1.8.1. Benefits from the DoD VE program are significant. In-house savings of approximately a billion dollars a year are being reported. Reported savings from the contractor VECP program are approximately $250 million, and are expected to increase. Benefits of this magnitude are noteworthy, but do not tell the full story. As important are the use to which these funds are put. The dollars that are made available through VE savings may be reapplied within the program, command, or DoD Component to provide the means to support approved but previously unfunded requirements. The money stays with the activity that achieves the saving and rewards those who are deserving. It can provide needed funds that are generated internally by sound management activities.

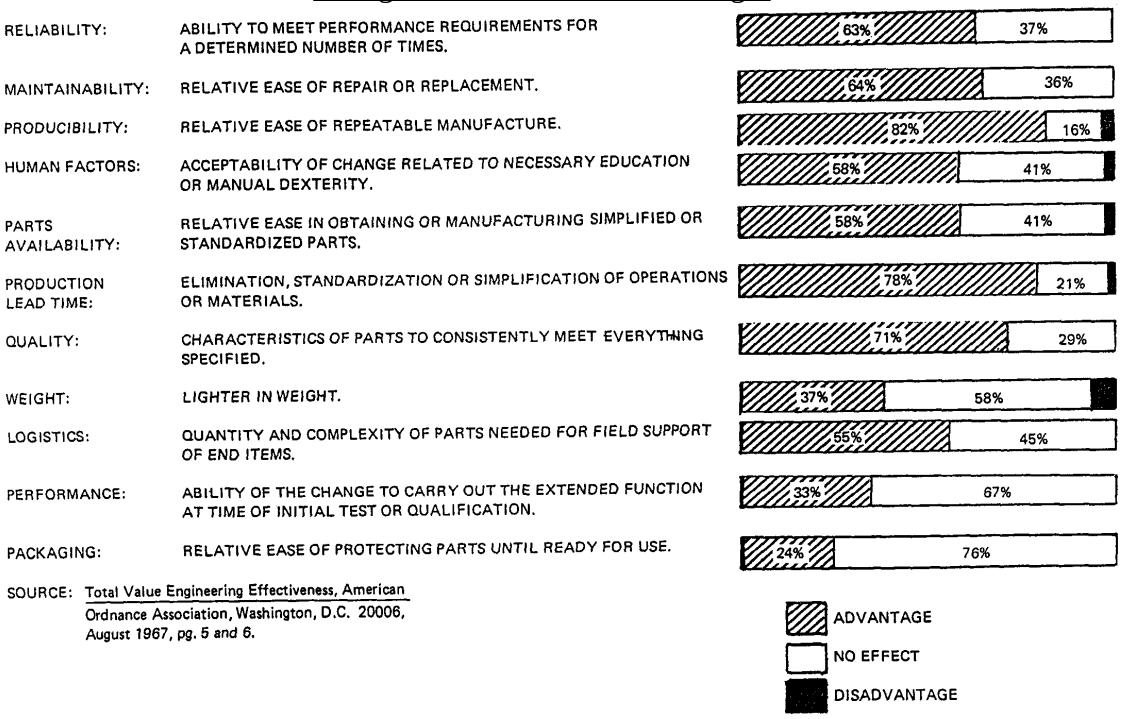
C1.8.2. For DoD contractors and subcontractors there are both direct and indirect advantages from the internal VE activities, as well as from VECPs. The most obvious direct advantage is that the defense contractor shares in the cost savings that accrue from implementing VECPs. Therefore, it is a tool for increasing the contractor's profit

through proposed changes in contract requirements. Changes may be proposed to contract specifications, purchase descriptions, or statements of work as long as they do not degrade essential quality, reliability, maintainability, or required performance of the item.

C1.8.3. A major indirect advantage for contractors and subcontractors in addition to the savings on approved VECPs is an enhanced competitive position by producing required products at lower costs. An active program establishes a reputation as a cost-conscious producer. A reputation of this nature can be beneficial. For contracts that are negotiated, VE successes may be considered when determining the Government's fee objective for the contract. Thus a contractor with an active VE program might obtain a larger fee than a contractor without one, all other things being equal. The net result of successful contractor VE is an improved profit structure, while the Government acquires needed defense capability with a minimum expenditure of tax dollars.

C1.8.4. VE also offers other benefits. For example, in an early assessment of the DoD VE program, the American Ordnance Association (now the American Defense Preparedness Association) reported the results of a survey it conducted at the request of the Department of Defense. The objective was to determine the impact on certain factors other than cost. This analysis was conducted on a random sample of 124 VE changes (taken from a total population of 660 changes). The survey revealed that VE made significant contributions toward improving the measured characteristics. Another later but more extensive survey corroborated the earlier findings and also identified why VE yielded these benefits. The specific benefits and the relative frequency of their occurrence are shown in Figure C1.F2.

Figure C1.F2. Total Value Engineering Effectiveness Sample Of 193 Implemented Contractor VE Changes Drawn From 2,627 Changes



C1.8.5. Thus, in addition to cost savings, VE often yields benefits such as: improved performance, relative ease of repair and replacement, repeatable manufacture, elimination of materials, standardization or simplification of operations, lighter weight, and improved use of resources.

C1.9. VE IN DoD CONTRACTS

Specific VE contract provisions are contained in the Federal Acquisition Regulation (FAR) and the DoD FAR supplement. These publications specify DoD acquisition policies. Their provisions enable a contractor to recover a portion of the savings that result from initiative and ingenuity in identifying and successfully challenging nonessential contract terms and provisions. These clauses are intended to foster a climate of cooperation, and managed change to permit the Government to acquire better, lower-cost items. Chapter 3 contains a detailed discussion of these contract clauses.

C1.10. SUMMARY

C1.10.1. The Secretary of Defense has placed increased emphasis on limiting the overall expenditures of the Department of Defense to the minimum necessary to achieve the capability to fulfill its mission. VE has become recognized as an effective contributor to this objective. It is an intensive review of requirements and the development of alternatives by the use of appropriate value techniques utilizing aspects of engineering, requirements analysis, the behavioral sciences, creativity, economic analysis, and the scientific method. Employed in an organized effort, it utilizes a systematic procedure for analyzing requirements and translating these into the most economical means of providing essential functions without impairing essential performance, reliability, quality, maintainability, and safety. There is no limit to the field in which VE may be applied. Its application can be considered at any point in the life cycle of a product. Experience has shown that the beneficial impact of VE is not limited to economic improvement. Significant improvements also occur in other attributes that are not always readily measurable in monetary terms.

C1.10.2. A successful VE program requires top management involvement. Each functional, project or acquisition manager must cooperate and participate to ensure an effective program. Line management is both responsible for and benefits from VE.

C2. CHAPTER 2

APPLYING VE

C2.1. CRITERIA

C2.1.1. If not used effectively, knowledge of VE techniques in itself is of little value. Like any profitable program or business, the successful VE program is based on an adequate return on investment. Normally a product line is selected on the basis of anticipated contribution to profit. Similarly, the selection of VE projects should be based on the potential yield from the time, talent, and cost that will be invested. The selection procedure should rank possible projects in order of potential return and probability of implementation. This enables the manager to determine that projects are likely to be the best investment.

C2.1.2. VE has been proved effective in environments such as the engineering laboratory, test facilities, procurement operations, construction projects, manufacturing facilities, and maintenance depots. It has been applied to a broad spectrum of items, procedures, systems, and equipment. The range continues to expand.

C2.1.3. A VE program includes a planned and organized set of specific tasks that support (or apply the VE discipline to) all major cost elements of an organization. Well-defined procedures lead practitioners through the essential steps of the process, and the execution of these steps generally involves the participation and coordination of personnel with diverse backgrounds.

C2.1.4. VE is directed toward analyzing the functions of an item. In this respect, it differs from most other cost reduction techniques. Some other techniques may reduce inherent quality by cheapening the product to reduce cost. The VE technique starts with a determination of the required function and then seeks lower cost alternatives to achieve that essential function. The objective is to identify and eliminate unnecessary cost without loss in needed quality or reliability.

C2.1.5. Functional analysis develops a "statement of function" for each part or element of the item being analyzed. Such functions are classified as basic and secondary. A basic function is one that cannot be eliminated without degrading the usefulness of the end item. A secondary function is not essential to operate the item in its intended application but is a consequence of the selected design solution. Limiting secondary functions and minimizing the cost of basic functions results in an item of "best value" that is consistent with all performance, reliability, quality, maintainability,

logistics support, and safety requirements. The term "best value" refers to the best relationship between worth and cost. In other words, a "best value" is represented by an item that reliably performs the required basic function at an appointed time and place and that has the lowest total cost.

C2.1.6. The VE program in the Department of Defense includes activities that do not necessarily use the function analysis technique. For example, activities organized to support the DoD Component Breakout, Competition, and Spares Management initiatives may not utilize all of the elements of the VE job plan as explained later in this Handbook. Similarly a rewardable VECP is one that complies with the terms of the specific contract and applicable acquisition regulations. An acceptable VECP does not have to be the result of a VE study. Although purposeful application of VE methodology is the greatest source of VECP savings benefits, on occasion, serendipity may also produce a rewardable contract change with little or no engineering content.

C2.2. EARLY VS. LATER VE

C2.2.1. The life cycle of a system or equipment begins with the determination that an operational deficiency exists or a new military capability is needed. Figure C2.F1. illustrates a common situation in which the savings potential decreases as the program ages. Early VE tends to produce greater savings or "cost avoidance" for two reasons. First, more units are affected by the savings actions. Second, earlier changes lower implementation costs such as testing, modifications to production lines, retooling expenses, and changes to operational support elements (e.g., spares, manuals, maintenance facilities, etc.). VE should be accomplished as early as possible.

C2.2.2. However, VE late in a program is precluded only in those rare instances where the cost of the VE effort and subsequent implementation would be greater than the savings potential. While later VE normally adds implementation costs and may affect smaller quantities, such deterrents can be more than offset by improved performance through advances in technology, additional available resources, more time, etc. There are always some opportunities that offer net savings at any stage of a program. For instance, one contractor activity reports that it was advised that it was probably too late in one program to submit VECPs. Nevertheless the group persisted and submitted VECPs for an additional 3 years. Of the 22 VECPs submitted since the purported cutoff, 12 were implemented.

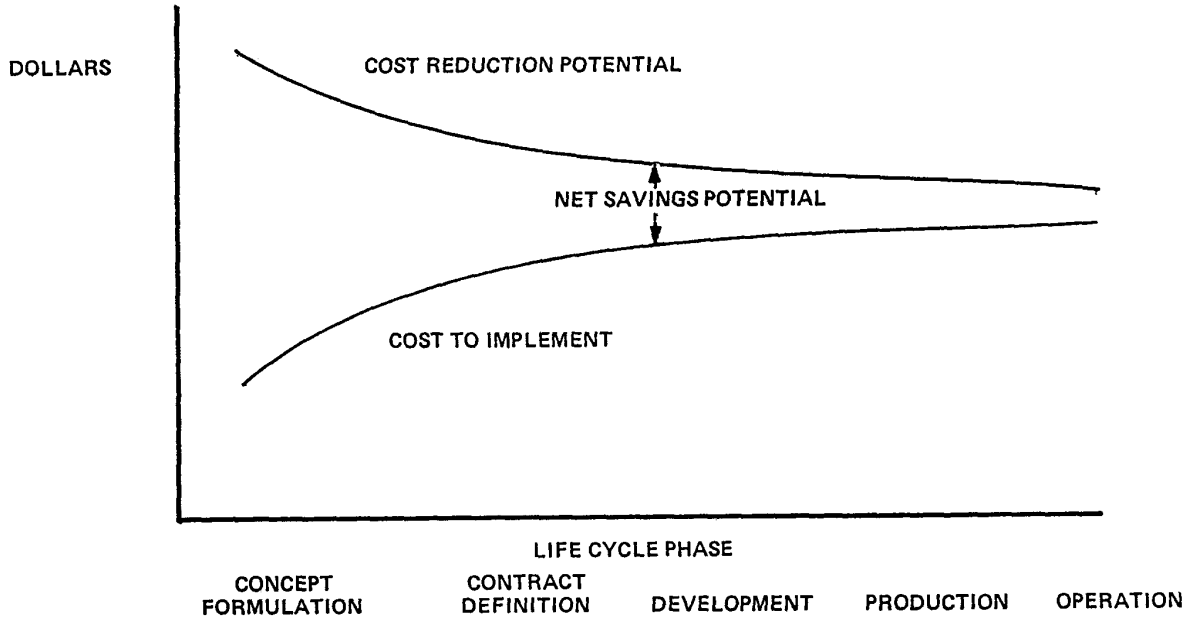
C2.2.3. Opportunities for certain types of proposals are frequently enhanced later in the life cycle. For instance, deletion of quality assurance testing often cannot be proposed until considerable experience is acquired and data gathered to prove that it is

not harmful. In another case, management reports required to understand the complex situation early in a program may turn out to be unnecessary during later phases of the program.

C2.2.4. The VE opportunity may be extended because the product life and total requirements are not known. Many items of defense material will be reprocured indefinitely. There is no way to estimate the total quantity that will be purchased. Examples are: clothing, ammunition, fire extinguishers, tires, etc. Many items, which entered the defense inventory in the past, were never value engineered. These items often benefit from a VE effort to the same extent as previously value-engineered products. The potential for VE savings on these items is great. Advances in technology or changes in user requirements provide a basis for potential savings greater than the cost of the study and subsequent implementation.

C2.2.5. Thus, VE may be applied at any point in the life cycle of an item or system where it is profitable to do so. Selection of the most appropriate time is influenced by many factors. Two of the most important are the magnitude of the savings likely from the effort and the ease or difficulty with which VE may be applied. VE in early stages is characterized by benefits that are difficult to measure. Often resulting "cost avoidances" are simply approximated. Later VE results in "before and after" examples whose savings may be forecast with greater accuracy.

Figure C2.F1. VE Savings Potential During Life of a Typical System



SOURCE: HELLER, E. D., GENERAL DYNAMICS CORP., SAN DIEGO, CALIFORNIA 92112

C2.3. PROGRAM LIFE CYCLE

C2.3.1. Concept Exploration Phase. The purpose of the concept exploration phase is to develop requirements and feasible concepts and define future operational and support requirements. Value improvement generated early in the life cycle produces benefits that may last throughout the life of the item or system. The engineering competence of VE personnel is of special importance in this phase. Analysis and decisions must often be made before the complete picture is available. The goal of low total cost (rather than just low acquisition cost) emphasizes the need for a VE organization competent in related acquisition, technical, and logistics fields. The VE effort in this phase furnishes guidance needed to ensure the most economical early program and design decisions. Use of the VE program requirement clause is most useful in the early phases before full-scale engineering development (FSED) when there is no baseline from which to propose changes.

C2.3.2. Demonstration and Validation Phase. The objective of the demonstration and validation phase is to ensure that the most promising system design concept(s) will be selected for FSED. During the validation phase, the contractors and Government can evaluate the system design concept(s) in terms of cost and value of operations,

maintenance, test, and supply support functions. Significant improvements in total cost can be achieved through the performance of VE during this phase.

C2.3.3. FSED Phase. The objective of this phase is to reaffirm the mission need and program objectives, complete the engineering design and ensure that system performance has been satisfactorily tested. VE can be used to analyze the essential requirements, military and technical characteristics, and the design tasks to develop possible alternatives offering improved value. Comparisons during this phase require special skills to validate the projected economic benefits. Evaluating initial prototypes, design layouts, and other details during the development phase may provide additional opportunities to improve value. Efforts in this phase are directed toward evaluations and recommendations concerning function, cost, and worth of specifications, systems, modules, assemblies, parts, and components. By defining value in measurable terms, VE can produce a functional cost analysis to improve visibility of the costs directly related to detailed requirements. This capability is most useful in supporting design to cost producibility engineering and planning, and other similar programs. VE is also used to support engineering activities such as design reviews, test planning and evaluation, life-cycle cost analysis, etc.

C2.3.4. Production Phase. During the production phase, VE can be applied to evaluate manufacturing processes, methods, and materials. Equally applicable are support and test equipment, supply transportation and handling, technical data, facilities, maintenance, and training.

C2.3.5. Operations Phase

C2.3.5.1. Ownership cost is affected by operating, maintenance, and other logistics costs. Reducing ownership costs (in excess of any attendant increase in acquisition cost) results in a lower total cost. Large potential savings often justify the investment for the VE study and subsequent implementation expenses during the operational phase. Studies during this phase offer an opportunity to make changes to incorporate new technology or to exploit mission or requirements changes. Sometimes new alternatives are a better choice than the item currently in the supply system.

C2.3.5.2. Studies during the operational phase by contractors and DoD personnel have resulted in:

C2.3.5.2.1. Extension of item life by the application of new state-of-the-art designs, materials, or processes.

C2.3.5.2.2. Reduced repair costs by achieving the repair function in a more economical manner.

C2.3.5.2.3. Reduction of packaging costs by improvements in packaging procedures or materials.

C2.3.5.2.4. Elimination of items.

C2.3.5.3. Figure C2.F2. summarizes the VE opportunities throughout the life cycle of a typical major program.

Figure C2.F2. Program Life-Cycle Opportunity

Life-cycle phase	System level	Program phase activity	Activity description
Concept Exploration	Mission	Function or objective	Clear definition of mission with stated function(s) or objectives in specific terms.
a. General operational	Mission performance characteristics.	System trade-off study, cost-effectiveness analysis, and value-engineering analysis	Review of mission requirement in terms of required performance. Review of existing system proposed systems involving advances in the state of the art.
b. Feasibility	System operational requirement.	Utility, go/no go determination	Program requirements baseline defined. Prepare system, subsystem, equipment, and component trade-off, initial cost/value effect, feasibility, and other studies consistent with mission and performance objectives.
Demonstration and Validation	System, sub-system equipment, and component.	System design, design trade-off studies, and specs required.	Expand operations, maintenance, test and activation functions.
			Determine additional design requirements for operations, maintenance, test, and activation.
			Identify and perform trade-off studies.

Figure C2.F2. Program Life-Cycle Opportunity, Continued

Life-cycle phase	System level	Program phase activity	Activity description
			Identify applicable requirements and update source documentation.
			System requirement review (performance cost/value, design data, etc.)
			System design review.
			Technical evaluation and system engineering synthesis. Design requirements baseline defined.
			Subsystem, equipment and component design, and cost/value trade-off within functional/performance specifications.
Full-Scale Engineering Development	Subsystem equipment and components	Subsystem design review and VE studies, test, and modification changes.	Design requirement baseline approved. Product configuration defined and approved. Conduct preliminary design reviews on operations/maintenance equipment and facilities.
Production	System, sub-equipment, and components	Evaluate manufacturing processes, methods, and materials	Conduct VE studies on manufacturing problems and contract requirements.
			Conduct critical design review on operations and maintenance equipment and facilities.
Operations (maintenance and logistic)	Equipment and component	Initial fabrication of changes (requiring Government approval and unilateral contr. changes)	Equipment and component review to further reduce cost within the established performance characteristics.

C2.4. PROJECT SELECTION

C2.4.1. Although the previous discussion focused on the VE opportunity throughout the life cycle of a typical hardware system, VE is not limited to hardware.

Other possible VE opportunities within the defense environment include: materials, organizational functions, software, construction, technical data, etc. Almost anything within the assigned responsibility of an activity is a possible opportunity. In the early stages of a VE program, sophisticated project selection criteria are not usually needed. Frequently there are numerous areas for which the need for VE is obvious and that offer a substantial return on investment.

C2.4.2. Those involved in beginning a new VE program or revitalizing a dormant one should select early projects that are most susceptible to VE. Initial projects should be selected that:

C2.4.2.1. Involve an ample dollar expenditure.

C2.4.2.2. Merit attention for reasons other than cost (i.e., deficiencies in performance, reliability, etc.).

C2.4.2.3. Are of interest to system or executive management.

C2.4.3. As the VE program matures and the opportunities become less obvious, additional criteria may be used to select subsequent tasks. Guidelines for each specific possibility are far too numerous to be included in this Handbook. However, some additional characteristics usually exhibited by worthwhile candidates are:

C2.4.3.1. No known deterrents such as exorbitant test costs or implementation schedule requirements.

C2.4.3.2. A product with excessive complexity.

C2.4.3.3. A design that utilizes the most advanced technology.

C2.4.3.4. An accelerated development program.

C2.4.3.5. An item that field use indicates is deficient in some characteristics such as excessive failure rate or extravagant operating cost.

C2.4.3.6. An item utilizing older technologies for which modernization appears very promising.

C2.4.4. Note that one of the attributes of VE is its ability to reveal to the rigorous user of the methodology cost improvement opportunities that might otherwise have remained invisible.

C2.5. VE JOB PLAN

C2.5.1. For those interested in a more detailed discussion of the VE job plan, please refer to Chapters 5 and 6 of this Handbook. The VE job plan may be summarized as a systematic, step-by-step application of the general problem-solving method: identify problem, solve problem, implement solution. Although there is no single best procedure, there are numerous ways in which VE techniques and practices can be supplemented, augmented, and adapted to conform to specific needs. Integrating these techniques and practices into a sequential procedure that is consistently productive is the core of the VE discipline. While the number of steps may vary, all job plans are characterized by an orderly progression through phases that include activities such as orientation, information, speculation, analysis, development and implementation, or something similar.

C2.5.2. In the orientation phase, the project is selected and those who are going to work the problem are familiarized with it. Projects may be selected because they represent the greatest potential for savings or are characterized as a high-dollar (valuable) item or are needed in large quantities and therefore represent a considerable expense. Often projects are selected for reasons other than just savings potential or high cost.

C2.5.3. The information gathering phase of the job plan includes researching the product selected to determine cost, function, and worth. The objectives of this research are:

C2.5.3.1. To develop a thorough understanding of the item under study; and

C2.5.3.2. To identify the specific value problem by including a functional analysis of the item accompanied by an estimate of the worth of each required function. Potential sources of factual information are drawings, manuals, specifications, cost and price information, work statements, and personal interviews.

C2.5.4. During the speculation phase, creative-thinking techniques are used to develop alternative approaches that will accomplish the required functions. Such techniques may be either organized, forced, or free. Criticism of potential solutions must not be permitted, nor should alternatives be analyzed in this phase. A large number of alternatives is desirable. Often organized creativity sessions set goals of 75, 100, or even 200 fresh ideas in order to ensure an adequate number.

C2.5.5. All alternatives generated during the speculation phase are evaluated during the analysis phase against the functional criteria as well as examined for technical feasibility and cost. The alternatives are ranked. None are discarded. The most promising alternatives are selected for detailed evaluation and development. If none of those originally selected offer an acceptable solution, another set is selected and developed. The process is repeated until a solution is found.

C2.5.6. In the development phase, final recommendations are developed from the alternatives selected during the analysis phase. Detailed technical and economic testing is conducted and the probability of successful implementation is assessed. The alternatives must be investigated in sufficient depth to permit the development of specific recommendations including an implementation plan. This must include making sure that the user's needs are satisfied; that the design is technically adequate; and that cost estimates, implementation expenses, and schedules are accurately estimated. Sound cost estimating is crucial when evaluating VE alternatives. It requires accurate information, expert judgments on cost allocations, and the inclusion of all pertinent cost elements in the analysis. At the conclusion of this phase, one or more alternatives should be recommended for implementation and an implementation schedule yielding the greatest overall benefit should be constructed.

C2.5.7. The presentation phase is actually presenting the best alternative (or alternatives) to those who have the authority to implement the proposed solutions that are acceptable. It includes preparing a formal VECP or value engineering proposal (VEP) that contains the information needed to reach a decision and implement the proposal.

C2.5.8. During the implementation and follow-up phase, management must ensure that approved recommendations are converted into actions. Until this is done, savings to offset the cost of the study will not be realized. Some degree of investment is usually required if a VE opportunity is to become a reality. Funds for implementation must be provided to support the actions necessary to capture the savings opportunity. Implementation progress must be monitored just as systematically as proposal development. It is the responsibility of management to ensure that implementation is actually achieved. Often the VE focal point or program manager is responsible for monitoring milestone achievement in the implementation plan.

C2.5.9. A VE project is not completed with implementation of an idea. Full benefit is not derived from a proposal until the follow-up is completed. Other applications of the proposal and actual results need to be established. Successful VE actions must be entered into the DoD VE database and cost savings and other benefits

reported through command channels. Until then, the records on a project cannot be closed.

C2.5.10. A complete VE evaluation should answer the following questions:

C2.5.10.1. Orientation:

-What is to be studied?

C2.5.10.2. Information Gathering:

-What is it?
-What does it do?
-What does it cost?
-What is it worth?

C2.5.10.3. Speculation:

-What else will do the job?

C2.5.10.4. Analysis:

-What do the alternatives cost?
-Which is least expensive?

C2.5.10.5. Development:

-Will the proposed alternative work?
-Will the proposed alternative meet requirements?
-What will the proposed alternative require?

C2.5.10.6. Presentation:

-What is recommended?
-What are the alternatives?
-What will it cost?
-How much will it save?
-What is implementation schedule?

C2.5.10.7. Implementation

-Has the proposal been approved, whole or in part, together with funding?
-Who is responsible for implementation?
-What actions have to be taken?
-Have completion dates been established?
-Have requirements for progress reporting been established?

C2.5.10.8. Follow-Up:

-Did the idea work?
-Did it save money?
-Would you do it again?
-Could it benefit others?
-Has it been forwarded properly?
-Has it had proper publicity?
-Should any awards be made?
-Has it been listed in the VE-trieval or VE Data Information Storage and Retrieval System (VEDISARS) databases?
-Has it been included in DoD VE savings reports?

C2.6. SUMMARY

C2.6.1. The choice of techniques varies with the phase of the life cycle and the situation in which the VE study is initiated. Between the conceptual and operational phases of a product, the available time, talent, and factors to be considered change. Although VE studies conducted in the conceptual and validation phases may offer a maximum opportunity for value improvement, potential dollar savings are often difficult to validate since there is generally no cost base with which to compare cost improvements. VE may be profitably employed early in the life cycle to challenge basic requirements and analyze preliminary designs. Also, functional trade-offs, systems analysis, and operations research techniques play a greater role than in later VE. Cost-estimating techniques also differ significantly since some details of the design may have to be assumed. As a product progresses along its life cycle, the VE methodology must be adapted to conform to the situation and the available data. Something value engineered in the conceptual phase may offer additional opportunities later. This is particularly true if the applicable technology is rapidly changing, or if original development schedules did not include time for an adequate effort. Excellent

opportunities exist to examine design requirements, development tests, operational tests, quality-assurance programs, and packaging requirements during the production phase. VE accomplished in the operational phase offers many opportunities for improvement in repair, packaging, and state-of-the-art materials, and process changes. Opportunities also exist in the operational phase for items that have never been reviewed or modernized.

C2.6.2. Initially, VE projects may be selected on the basis of dollar volume, complexity, and degree of management support. Later, as projects with significant potential become less obvious, selection may be based on such additional factors as test costs, state of the art, degree of development, time compression, and field-problem reports. The VE job plan is the framework upon which a successful effort is built. When utilized properly, it ensures a systematic approach to the identification and capture of a value opportunity. It provides for a thorough understanding of the subject including a quantitative identification of the nature and worth of the functional requirements. Uninhibited creative effort then may suggest alternative approaches to achieve all functions needed by the user. This is followed by a series of evaluations to select, develop, and implement the alternative offering the best opportunity for value improvement. No project is complete until proposals are implemented, results tallied, and new knowledge exploited as fully as possible.

C3. CHAPTER 3

CONTRACTUAL ASPECTS OF VE

C3.1. INTRODUCTION

C3.1.1. Prior to the publication of the VE portions of the acquisition regulation, there was little or no financial incentive for a contractor to submit engineering change proposals that saved money. Until then the usual result of Government acceptance of a contract cost-reduction change proposal was a reduction in the contract value. This reduction was generally accompanied by an attendant reduction in profit or fee. Since a contractor's success was derived from fees and expected profit, reluctance to propose cost-reduction actions in such circumstances is understandable. Now a positive incentive has been created through the development of the DoD VE contract clauses.

C3.1.2. "It is now DoD policy to promote VE actions that will reduce cost and improve the productivity of DoD in-house and contractor resources."[1] One of the results of a purposeful contractor VE program is expected to be contract or engineering change proposals that offer a saving to the Government and thus are VECPs. However, acceptance of a VECP does not depend upon it being the result of using the VE methodology. In fact, a VECP must meet only two criteria:

C3.1.2.1. It requires a change to the contract; and

C3.1.2.2. It saves money for the Government.

C3.1.3. The DoD VE contract clauses encourage industry to challenge unrealistic Government requirements and specifications and to profit by doing so. These clauses are unlike other contract incentives that reward efficient performance according to the stated terms of the contract. VE contract clauses reward the contractor who proposes acceptable changes to the contract that will result in equal or better but lower-cost defense products. These changes are mutually advantageous to the Government and the contractor because both share the resultant savings. The DoD VE contract clauses encourage entrepreneurship by rewarding contractors equitably for their initiative in developing VECPs.

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[1] DoD Directive 4245.9, "DoD Value Engineering Program," May 7, 1984.

C3.2. BENEFITS

C3.2.1. To the Department of Defense

C3.2.1.1. The Department of Defense is interested in VE contract clauses for two reasons. First, VE generally improves or updates the product. The American Ordnance Association (AOA) studies (Figure C1.F2.) demonstrated that VE generally results in a better product. The Genesis of VE Opportunity Study (Figure C1.F1.) indicates that even a well-designed product can usually be improved due to the subsequent availability of more information, added insight, or new technology. Second, VE is a convenient means to foster greater economy. In his December 14, 1979, affordability and VE letter to the Military Services, the Deputy Under Secretary of Defense (Acquisition Policy) suggested an annual goal for VECP savings of 0.7 of 1 percent of the procurement Total Obligational Authority (TOA) (as expressed in the January P-1 document supporting the President's budget) was reasonable and attainable. To date reported VECP savings, while impressive, do not reflect the full potential of the contractor VECP program.

C3.2.1.2. It should be noted the savings that have been reported are based on conservative estimates. It is possible that the actual savings will exceed those reported. The benefits usually remain with the program, command, or DoD Component implementing the proposal. The funds that are thus freed can be reapplied within the program, command, or component for authorized but unfunded requirements. Savings benefits are an acceptable way to generate the ability to pay for what would otherwise be unaffordable.

C3.2.2. To DoD Contractors

C3.2.2.1. It might be well to emphasize that VE contract clauses are but one of the means by which a good VE program can contribute to a contractor's competitive position and profit. Others are:

C3.2.2.1.1. Pre-contract VE can help make proposals more attractive to the customer.

C3.2.2.1.2. VE is frequently a factor in source selection. Other things being equal, it could be a decisive factor.

C3.2.2.1.3. VE successes can be an element in the contract-performance evaluation program.

C3.2.2.1.4. As an element in the weighted guidelines, past VE performance may contribute to improved negotiated fee or profit on new contracts.

C3.2.2.1.5. Benefits from unilateral (Class II) contractor VEPs usually revert entirely to the contractor.

C3.2.2.1.6. The contractor may benefit financially by sharing in VE savings offered by subcontractors.

C3.2.2.2. But, the primary stimulus to encourage participation by contractors is the profit motive, as shown by the following statistics:

C3.2.2.2.1. Of over 5,000 contractor VECPs submitted, about 50 percent have been approved to date.

C3.2.2.2.2. Contractors earn about 43 cents for each dollar the DoD saves through approved VECPs.

C3.2.2.3. The objective of the DoD VE program is to motivate the defense contractor to practice VE and to exercise the VE provisions in their contracts by submitting VECPs. The incentives are the money they receive from a share of the cost savings resulting from the approved changes to their contracts. Contractors are also encouraged to include VE sharing arrangements in subcontracts and to benefit by doing so.

C3.2.2.4. The acceptability of a contractor's VECP is dependent upon the knowledge, insight, and care applied during its preparation and processing. In return, the Government owes the contractor fair, timely, and objective evaluation of VECPs. The purpose of this Chapter is to provide information and suggestions that will contribute to the effectiveness of the contractor's VE efforts. It is designed to answer questions concerning the What-Why-When-Where-Who- and How of contractual VE.

C3.3. WHAT A VECP IS

C3.3.1. A VECP is a proposal submitted by a contractor to the Government in accordance with the VE provisions of the contract. It proposes a change that, if accepted and implemented, provides an overall cost savings to the Government. The VE provisions in a contract permit the contractor to share in the savings that accrue from implementing the change. In other words, the VECP provides the means to lower defense costs while increasing the contractor's rate of return on investment. Thus, the

VECP becomeichboth a contractor and a Government management tool. This definition includes VECPs that would produce collateral savings in Government-furnished property (GFP), operations, maintenance, or other areas that exceed any increased acquisition cost and do not impair functions or characteristics.

C3.3.2. In order to qualify as a VECP so that a savings can be shared, the proposed change must meet two primary requirements:

C3.3.2.1. It must require a change to the instant contract to implement; and

C3.3.2.2. It must provide an overall cost savings to the Government without impairing essential functions or characteristics, provided that it does not involve a change:

C3.3.2.2.1. In deliverable quantities only.

C3.3.2.2.2. In Research and Development (RD) quantities or test quantities due solely to results of previous testing under the instant contract.

C3.3.2.2.3. To the contract type only.

C3.4. THE PRELIMINARY VECP

C3.4.1. The term preliminary VECP is derived from MIL-STD 480 and is used in a similar manner. It is not a mandatory form. A preliminary VECP can be used to submit an initial proposal to the Government before the submission of a final VECP. Use of a preliminary VECP is appropriate when the development of the final VECP would require a contractor to risk significant funds. The contractor may use the preliminary VECP to notify the Principal Contracting Officer (PCO) of the initial proposal, provide information concerning the potential for cost reduction, indicate the approximate costs for developing the VECP and the estimated savings that might be achieved, and an early assessment of advantages and disadvantages.

C3.4.2. The PCO typically forwards a preliminary VECP to the Engineering Support Activity (ESA) for an initial evaluation to ensure that the proposal has technical merit and deserves to be developed into a final VECP submission. Often this results in discussions between the Government and the contractor until a suitable understanding is reached. The PCO then indicates whether the idea deserves additional study, or should not be pursued any further due to circumstances known to the PCO or the ESA. The contractor should be aware that an indication from the PCO that the idea has potential, does not guarantee that the final VECP submission will be accepted. As with any

VECP, there is still the possibility that it might be rejected, and there is, therefore, some element of risk involved. The idea behind the preliminary VECP is to reduce this risk so that the contractor does not expend significant funds on ideas that have little or no chance of being accepted.

C3.4.3. Use of the preliminary VECP carries with it some risk in multiple-source situations. A contractor would have to weigh the risks of inadvertent disclosure to a competitor versus the risk of investing time and money for a VECP that is of little or no interest to its customer.

C3.5. TYPES OF VE PROVISIONS IN DoD CONTRACTS

C3.5.1. The FAR of April 1, 1984, and the DoD FAR Supplement prescribes the DoD VE contract clauses. They also establish policy and procedures for the program or buying office to use to construct the VE arrangements in a particular contract or on a specific acquisition program.

C3.5.2. FAR Sections 52.248-2 and -3 describe clauses for use in architect-engineer and construction contracts respectively. For weapon systems and weapon system elements, the FAR Section 52.248-1 provides two basic alternatives:

C3.5.2.1. An incentive approach in which contractors take part voluntarily; and

C3.5.2.2. A mandatory program through which the Government requires and pays for a specific level of VE effort. A combination of the two approaches may be used in some instances. A discussion of these two approaches follows:

C3.5.2.3. Value Engineering Incentive (VEI)

C3.5.2.3.1. The basic VEI is used in supply and service contracts and subcontracts for:

C3.5.2.3.1.1. Spare parts and repair kits of $25,000 or more for other than standard commercial parts.

C3.5.2.3.1.2. Other contracts with a value of $100,000 or more.

C3.5.2.3.2. The VEI may be included in supply or service contracts of lesser value if the contracting officer determines there is a potential for significant savings. Exceptions to this policy include contracts for: research and development (other than FSED), engineering services from not-for-profit organizations, personal

services, product or component improvement (unless the VE clause application is restricted to areas not covered by the provisions for product or component improvement), or standard commercial items that do not involve any special requirements or specifications.

C3.5.2.3.3. The VEI provisions of a contract do not obligate the contractor to take any action. The VEI clause is intended to encourage the contractor to take part voluntarily by sharing with the contractor the actual or estimated cost savings the Government receives from VECPs that the contractor undertook on its own initiative.

C3.5.2.3.4. The FAR provides for payment of the costs of preparing a VECP if it is accepted. The contractor and the Government share in the net savings. Development costs related to unsuccessful VECPs are generally not allowed in accordance with the cost allowability principles of the FAR.

C3.5.2.4. Value Engineering Program Requirement (VEPR)

C3.5.2.4.1. In addition to the basic VEI clause, the FAR provides an alternate provision that allows the contracting officer to incorporate into a contract a mandatory VE activity known as the VEPR. The VEPR is a separately priced line item in the contract that specifies a certain level of VE activity and the portion (or portions) of the contract work to which it applies. Benefits are expected not only from the submission of VECPs, but also from a continuous VE effort by the contractor in order to get results earlier. Thus, drawings, specifications, methods, and processes will reflect the full benefit of VE in the initial stages of design, development, and production. The contractor may be required to submit reports reflecting the results of this effort. Within the Department of Defense, MIL-STD-1771 is used to establish minimum contractor requirements and standards of performance for the VEPR. The sharing arrangements for approved VECPs originated under VEPRs are less for the contractor than the share provided for VECPs submitted under the VEI.

C3.5.2.4.2. The contracting officer may incorporate both the VEI and VEPR clauses into the same contract. The VEPR is restricted in the contract schedule to a specifically defined performance areas, while the basic VEI clause is used to cover the remaining areas of the contract.

C3.6. SHARING VECP SAVINGS

C3.6.1. There are two basic types of savings that can be shared when a VECP is approved and implemented. They are acquisition and collateral savings.

C3.6.1.1. Acquisition Savings

C3.6.1.1.1. Supplies and Services

C3.6.1.1.1.1. Acquisition savings may include savings from the instant contract, concurrent contracts, and future contracts. The VECP is submitted under the instant contract. If the VECP is accepted and implemented on items delivered on the instant contract, the contractor receives a percentage of the net savings that accrue as a result of the VECP. In calculating these savings, contractor costs of developing and implementing the VECP and the Government's cost of implementation are all subtracted from the gross saving before sharing begins. Therefore, it is important that the contractor identify and record (for audit purposes) the costs incurred in developing and implementing the VECP. Development costs are expenses incurred after it has been determined that a VECP will be prepared and before the Government accepts the VECP. Implementation costs are expenses that will be incurred to implement the change after the VECP has been approved. All development and implementation costs must be offset before any sharing of acquisition savings may occur.

C3.6.1.1.1.2. Concurrent contracts are those current contracts awarded by the acquisition activity to the contractor or other contractors for essentially the same item. If the contracting office directs that the VECP be incorporated into concurrent contracts, the contractor originating the VECP will share in the net reduction in price that are negotiated on concurrent contracts. The contractor does not begin to share concurrent contract savings until all costs of developing and implementing the VECP are offset.

C3.6.1.1.1.3. To the degree that instant contract savings exceed development and implementation cost, these savings represent a reduction in the dollars associated with the current contract as well as a planned reduction in the amount of con-current and future contracts. The contractor's share of the savings, by definition must be less than the total, and is intended as partial compensation for the loss in current and potential future billings resulting from the accepted VECP.

C3.6.1.1.1.4. Future contracts are for items incorporating the VECP that are awarded after the VECP is approved. Future contract savings may be shared on all affected items scheduled for delivery within 3 years after the first item that incorporates the VECP is accepted. These future contract savings may be shared in one of two ways. The first is through a series of payments made for the contractor's share of savings as future contracts are awarded. This method of sharing is referred to as the

"royalty" method. Under an alternate procedure, known as the "lump sum" method, the instant contract may provide that the contractor accept its share of future contract savings in one lump sum, based on the contracting officer's projection of the total number of units that will be delivered during the sharing period. Under both methods, the contractor's share of future contract savings is added to the instant contract price. The instant contract, therefore, cannot be completed until all VECP savings awards to the contractor have been made.

C3.6.1.1.1.5. For multi-year contracts that run for more than 3 years after the first item is accepted, the sharing period covers all items accepted before the originally scheduled contract completion date. If the VECP is submitted during the design or limited-production phase, future sharing is based on that quantity of units produced during the highest 36-consecutive months of anticipated production based on the Five-Year Defense Program (FYDP) or other planning documentation existing when the VECP is accepted.

C3.6.1.1.1.6. The sharing rates (Government/contractor) for acquisition savings for supplies and services are based on the type of contract, the VE clause, and the type of savings as shown in Figure C3.F1.

Figure C3.F1. Government and Contractor Sharing Rates

For Supply and Service Contracts, the sharing ratios are:

Type of Contract	VE Incentive (Voluntary)		VE Program Requirement (Mandatory)	
	Instant	Concurrent and Future	Instant	Concurrent and Future
Fixed-Price (Other than incentive)	50/50	50/50	75/25	75/25
Incentive (Fixed-price or cost)	*	50/50	*	75/25
Cost-reimbursement** (Other than incentive)	75/25	75/25	85/15	85/15

*Same ratio as the contract's cost incentive ratio.

**Includes cost-plus-award-fee contracts.

C3.6.1.1.2. Construction

C3.6.1.1.2.1. A separate VE clause (FAR 52.248-2) is used for construction contracts. Sharing on construction contracts applies only to savings on the instant contract. The sharing rates (Government and contractor) are as follows:

Fixed-Price*	45/55	Cost Reimbursement*	75/25

*Other than incentive.

C3.6.1.1.2.2. For incentive contracts, sharing is the same as the contract cost incentive ratio.

C3.6.1.1.3. Architect-Engineer. The basic VEI clause may not be used for Architect-Engineer (A-E) contracts. When the VEPR is included in an A-E contract, the clause (FAR 52.248-3) makes no provision for sharing on accepted VECPs resulting from the paid VE effort.

C3.6.1.1.4. No-Cost Settlement

C3.6.1.1.4.1. In order to minimize the administrative costs for both parties on small dollar individual VECPs, consideration should be given to the settlement of a VECP submitted against the VEI clause of the contract at "no cost" to either party. Under this method of settlement, the contractor would keep all of the savings on the instant contract, and all savings on its concurrent contracts only. The Government would keep all savings resulting from current contracts awarded to other contractors, savings from all future contracts and all collateral savings. Use of this method must be by mutual agreement of both parties for individual VECPs.

C3.6.1.1.4.2. The benefits of an accepted VECP should not be rewarded both as VE shares and pursuant to performance, design-to-cost, or similar incentives of the contract. Thus, when performance, design-to-cost, or similar targets are set and incentivized, the targets of such incentives affected by the VECP are not adjusted because of the acceptance of the VECP. Only those benefits of an accepted VECP that are not rewardable under other incentives are rewarded under a VE clause.

C3.6.1.2. Collateral Savings

C3.6.1.2.1 Collateral savings are measurable net reductions in costs of operation, maintenance, logistics and support alternatives, shipping costs, stock levels,

or GFP when these savings are a result of an accepted VECP. In some cases, a VECP may increase the acquisition cost of an item but result in larger collateral savings. For collateral savings, the contractor is entitled to 20 percent of the net savings that the purchasing office estimates will be realized during an average 1-year period. However, the contractor's share cannot exceed $100,000 or the contract's firm-fixed-price, target price, target cost, or estimated cost at the time the VECP is accepted, whichever is greater. The amount of collateral savings is determined by the purchasing activity, and its determination is not subject to the "disputes" clause of the contract. Collateral savings provisions are included in contracts whenever an opportunity may exist for savings. They are intended to focus the contractor's attention on savings benefits other than acquisition savings. However, because the savings share is not intended as a partial replacement for a reduction in the contractor's current or future billings, the contractor's share of collateral savings, although substantial, is nonetheless smaller than its share of acquisition savings.

C3.6.1.2.2. The collateral savings provision may be excluded from a contract at the discretion of the head of the contracting activity. This is done when it is anticipated that the cost of computing and tracking collateral savings is more than the benefits to be derived. Collateral savings may be deleted from contracts for supplies and services as well as construction contracts.

C3.7. SUBCONTRACTOR VE

C3.7.1. Prime defense contractors are encouraged to extend VE to their subcontractors. The FAR requires prime contractors to extend VE to their subcontractors on contracts of $100,000 or greater. Subcontracts for spare parts of $25,000 or more, for other than commercial items, are also to include VE provisions. However, VE may be extended to subcontractors on contracts of lesser value. Prime contractor to subcontractor VE arrangements can extend to the subcontractor a part of whatever share the prime contractor receives, including the instant or concurrent contract share, collateral share, and future contract share. The subcontractor must submit VECPs to the prime contractor who, in turn, submits them to the Government, if appropriate.

C3.7.2. The sharing between the prime and the subcontractor is a matter for negotiation between them and should provide encouragement for the subcontractor to pursue VE and to submit VECPs to the prime contractor. It may also provide a savings share to the prime contractor, who is responsible for editing a subcontractor's VECP into proper format and for presenting it to the Government. Any subcontractor development and implementation costs and the share of instant contract savings

extended to the subcontractor are considered part of the prime contractor's development and implementation costs. However, note that agreements made between the prime contractor and the subcontractor cannot reduce the Government's share of concurrent, future, or collateral savings.

C3.8. VECP POTENTIAL

C3.8.1. A VECP may be submitted any time the contractor has an active DoD contract with a VE clause. VECP savings are usually time dependent. The potential savings are affected by the total quantity remaining to be produced and the non-recurring costs incurred to develop and implement the proposal. VECPs originated during the early stages of a program usually produce greater savings because they apply to a larger number of units and implementation costs such as changes to tooling, facilities, drawings, and manuals are not as great. As a program matures, the savings benefit per VECP may decrease but the potential for VECPs may increase due to advancing technology. As long as the potential savings exceed the cost of developing and implementing a VECP, the VECP can be beneficial.

C3.8.2. Many items in the DoD inventory are procured according to old specifications in large quantities on a regular basis. Due to advances in technology, materials, and processes, the specifications that apply become outdated and may force "technology regression" on a contractor to produce from the old specifications. Therefore, any items procured on a repetitive basis to old specifications are good candidates for VE. VECPs may be used to add a qualified, low-price, new source to a drawing if the Government has not previously required or funded the second source effort.

C3.8.3. Another potential for VE may be found in items that were designed on a stringent schedule to meet urgent requirements. Under these conditions, the designers often incorporate the known components or subsystems into the design simply because time would not permit qualification of an improved substitute. Subsequently, a newer, less expensive or more reliable alternative may have been developed and proven that can be introduced by submitting a VECP.

C3.9. VECP BASIC REQUIREMENTS

The VECP should be prepared with sufficient information so that a thorough evaluation may be conducted by the Government with mimimum delay. The FAR requires that as a minimum, the following information be submitted with a VECP:

C3.9.1. A description of the difference between the existing contract requirement and the proposed change, and the comparative advantages and disadvantages of each.

C3.9.2. A listing and analysis of each contractual requirement that must be changed if the VECP is accepted, plus any recommendations the contractor may have for changing specifications.

C3.9.3. A detailed cost estimate for both the old and proposed methods. The contractor must account for estimated development and implementation costs including any costs attributable to subcontractors. Also, the contractor must include a description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation as well as any changes in operating and support costs or procedures.

C3.9.4. A prediction of the collateral cost saving or increase that the Government would experience if the VECP is implemented.

C3.9.5. Identification of the time that a contract modification implementing the VECP must be issued in order to get maximum savings, plus any effect it will have on the delivery schedule or contract performance time.

C3.9.6. Identification of any previous submissions of the VECP, including the dates submitted, agencies involved, numbers, and previous actions by the Government.

C3.9.7. Identification of the unit (item or task) to which the VECP applies.

C3.9.8. Statement that it is being submitted according to the VE clause.

C3.10. VECP PREPARATION

C3.10.1. Although the FAR clause relative to VE does not specify a particular format in preparing a VECP, it is highly probable that either DoD-STD-480A or MIL-STD-481A is listed as a contract requirement. One of these standards, both of which are entitled "Configuration Control," governs the format to be followed in submitting a VECP if they apply. A review of the contract determines that, if either, of these standards applies. If neither is specified, the contracting officer may specify the format to be used.

C3.10.2. A transmittal letter for each VECP sent to the contracting officer is an important ingredient for a successful action. It should state that the VECP is being

submitted pursuant to the VE clause of the contract. Also, it should summarize the contents of the VECP. It should briefly state the estimated cost changes, the nature of the proposed change, and the reference where complete details can be found in the proposal. The transmittal letter also serves as a marketing document that brings out the highlights of the proposals. It should emphasize the technical advantages and cost benefits to the Government. If the VECP contains data the contractor wishes to restrict, a statement to that effect must be included in the proposal. Figure C3.F2. is an example of a VECP format.

C3.11. VECP DATA RIGHTS

C3.11.1. When the proper legend is affixed to a VECP, the data therein shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a VECP submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the contractor or from another source without limitations. Failure to identify, mark, and propose data rights in an accepted VECP allows the Government to have unlimited rights to all data in the VECP as well as supporting data.

C3.11.2. If a VECP is accepted, the contractor grants the Government unlimited rights in the VECP and supporting data. Except that, with respect to data qualifying and submitted as limited rights technical data, the Government has the rights specified in the contract modification implementing the VECP.

C3.11.3. The Government has the right to furnish the listed technical data to a supplier for performance of work required to implement the VECP, but must protect the proprietary data from unauthorized use, duplication, or disclosure.

C3.12. CONTESTED VE DECISIONS

C3.12.1. The courts have been reviewing cases and handing down appeal decisions since 1963. These decisions help to clarify the Federal regulations and must be taken into account in those areas where the actions are germane.

C3.12.2. These decisions are published regularly as "Armed Services Board of Contract Appeals Decisions," "Contract Cases Federal," "Comptroller General Board Cases," and "U.S. Court of Claims Decisions."

C3.12.3. They can be found through the publications of the Commerce Clearing House, 4025 W. Peterson Avenue, Chicago, IL 60646. "A Compendium of Contested Values Engineering Actions" is also available from the Electronics Industries Association, 2001 Eye Street, N.W., Washington, DC 20006.

Figure C3.F2. Sample VECP Format

NOTE TO CONTRACTORS:

The attached VECP and the transmittal letter shown below are samples of the minimum information which must be submitted by the contractor to meet the requirements of Part 48, "Value Engineering," of the Federal Acquisition Regulation (FAR).

XYZ MANUFACTURING CO.
MAIN STREET
YOURTOWN, STATE ZIP

DATE: _____

SUBJECT: Contract No. , Value Engineering Change Proposal, VECP - No. 3, Redesign Antenna Support, P/N 3001-1

TO: _____

NOTE TO CONTRACTOR:

Fill in procuring contracting officer's name, title, procuring agency, and address

Enclosures: 1. Value Engineering Change Proposal No. 3.
2. Drawing of proposed Antenna Support.
3. Test report.

1. The attached Value Engineering Change Proposal is submitted pursuant to Contract No. _____, General Provision No. _____ titled "Value Engineering Incentive."

2. This proposal contemplates a reduction in cost of the Antenna Support through redesign, change of material, and improved manufacturing procedures. The proposed change will be accomplished without sacrifice to system integrity and reliability.

Sincerely,

X. Y. Zee
President

Copy furnished:
DCAS Area Office
ATTN: ACO

Figure C3.F2. Sample VECP Format (continued)

VALUE ENGINEERING CHANGE PORPOSAL NO. 3

1. Difference between existing and proposed Antenna Support.

a. Existing Support:

The present design consists of a plate formed from .032 thick 6061 aluminum alloy sheet which mates with the aircraft fuselage nose section. The plate is welded to a .025 thick 6061 aluminum alloy tube which is formed by rolling and welding. Standard tubing is not used because of the size required. An adapter is supplied by the Government to mate with the antenna element.

b. Proposed Change:

The new support assembly shall be formed fiberglass with an integral mounting flange and adapter assembly. The assembly shall be impregnated with epoxy resin Type 1, Class 2, per MIL-R-9300. The support will have a .032 wall thickness and a .050 flange thickness. The drilling of six attachment holes and the addition of a grounding strap will complete the assembly.

c. Comparative Advantages and Disadvantages:

(1) The proposed antenna support will be:

(a) Interchangeable with present support assemblies.

(b) Lighter by 2.5 pounds.

(c) Resistant to corrosion.

(d) Permanently colored to match the aircraft's color scheme.

(2) We foresee no disadvantages to this proposed change.

2. Recommended changes to contract and identification to unit:

a. Delete line item number 1: P/N 3001-1 mfg. in accordance with Gov't Procurement Package number 3001-81996, Revision C., dated, 3 January 19XX.

b. Delete requirement for Government furnished adapter, P/N 1234.

Figure C3.F3. Sample VECP Format (continued)

c. Add new line item number 1: Williams Manufacturing Company P/N WMC 3001-1, manufactured in accordance with WMC drawing number 3001, dated 1 November 19XX.

3. Reduction in contract cost:

a. Current contract unit price	$36
b. Estimated unit price of proposed part	23
c. Gross estimated unit saving (a-b)	$13
d. Total gross savings (2000 @ $13)	$26,000
e. Estimated contractor non-recurring costs for VECP development and implementation (includes engineering development, prototype, testing and production tooling)	5,000
f. Net savings (d-e)	$21,000

4. Estimated Government cost for implementing VECP

Test and evaluation	$3,000

5. Reduction in collateral costs

Elimination of Government furnished adapter (2000 @ $4.00)	$8,000

6. Required approval date for maximum savings:

Indicate date (day, month, year) by which approval is required to achieve maximum savings.

7. Submittal of Previous Proposals:

This proposal has not been submitted under previous Government contract.

NOTE TO CONTRACTORS:

Add any other information pertinent to your VECP. Example: Cost to qualify new item, drawings, sketches, photographs, restrictive data rights per FAR.

C3.13. VECP DISTRIBUTION

The FAR governs the distribution of a VECP. It requires that VECPs be sent to the PCO and, when the contract is administrated by other than the purchasing agency, a copy of the VECP must be sent at the same time to the administrative contracting officer (ACO). It is extremely important that the ACO receive a copy of each VECP as the ACO is responsible for periodic follow-up with the PCO on all VECPs during the evaluation process. Also, the ACO must be made aware of a VECP to expedite its evaluation and to support the decision process by the PCO and the ESA.

C3.14. GOVERNMENT RESPONSE

C3.14.1. A response to the contractor is due within 45 days. If it is not possible to evaluate and reach a decision by that time, then the PCO shall notify the contractor of the status of the VECP within 45 calendar days after it is received by the contracting office. The contractor shall be provided the reason for the delay, and be advised of the expected date of the contracting officer's decision. VECPs will be processed expeditiously. However, the Government assumes no liability for delay in acting on them.

C3.14.2. The PCO shall accept the VECP by modification to the contract. If the VECP is not accepted, the contracting officer shall write the contractor explaining the reasons for rejection. The contractor may withdraw, in whole or in part, any VECP not accepted by the Government within the period specified in the VECP. The decision whether or not to accept a VECP rests solely with the PCO and may not be disputed by the contractor.

C3.15. SUMMARY

DoD contracting officers are expected to encourage prime contractors to submit VECPs that reduce cost and to offer a reasonable share of the resulting savings as a reward for the effort undertaken by the contractor. There are two types of VE contract clauses. The VEI clause entitles the contractor to a share of the savings resulting from accepted proposals that it initiates. The second clause is the VEPR that requires the contractor to undertake a specified VE program as a contract line item in accordance with MIL-STD-1771. For supply and service contracts, either clause entitles the contractor to share in savings, not only on the instant contract, but also on concurrent contracts, future contracts, and collateral savings. The VE sharing rates are standardized

for instant, concurrent, and future contracts, depending upon the VE clause and type of contract. Prime contractors are encouraged to extend VE to their subcontractors. The preparation and format of the VECP should be in accordance with the requirements contained in the contract or as specified by the contracting officer. Government personnel are expected to process the VECPs as expeditiously as possible, and to keep the contractor informed as to the status of VECPs.

C4. CHAPTER 4

MANAGING THE DoD VE ORGANIZATION

C4.1. INTRODUCTION

To be successful and attain its full potential, a management program requires close supervision by those responsible for achieving its objectives. This is particularly true of VE because of the critical need to allocate scarce VE resources to maximize the return on their use. This chapter discusses some of the considerations for a manager seeking to organize, operate, and measure a VE program in the Department of Defense. Collectively they provide a method of directing VE efforts toward a maximum contribution to better value.

C4.2. DEVELOPING A VE POLICY

C4.2.1. VE programs in industry and Government are usually intended to be a purposeful, planned approach to cost reduction, which make use of the best relevant tools of science, engineering, and industrial management. Establishment of such a program does not, of itself, ensure an effective approach to cost reduction. A productive VE capability requires strong and active top management involvement. A powerful indication of this is an affirmative policy statement on VE issued by top management. Within the Department of Defense, involvement is demonstrated by the policies contained in DoD Directive 4245.8, "DoD Value Engineering Program," May 7, 1984.

C4.2.2. Each DoD Component subsequently issued a document implementing its program in accordance with the policy statement issued by the OSD. Although overall uniformity is desirable, nevertheless, each subordinate element tailored its policies to satisfy its needs and comply with its procedures. Generally these implementing Directives include requirements to:

C4.2.2.1. Centralize policy direction and responsibility for ensuring implementation of overall VE policies.

C4.2.2.2. Establish VE goals for subordinate components.

C4.2.2.3. Initiate procedures for periodic management review of progress and overall status.

C4.2.2.4. Expedite the objective evaluation of VEPs and VECPs and related contract changes.

C4.2.2.5. Ensure that personnel charged with various facets of the DoD VE program are adequately trained.

C4.2.2.6. Provide adequate funding to operate and support VE activities.

C4.2.3. A statement of policy from top management does not guarantee a successful program. Management must demonstrate continuing personal involvement to emphasize the importance of the program and to encourage participation at all levels of the organization.

C4.3. NATURE OF THE VE INVESTMENT

C4.3.1. Total Benefits. The intent of a VE effort is to minimize the total cost of a product or capability. VE is a means to help the line organization improve the value of the product. VE efforts have produced both dollar savings and non-monetary benefits. Although the non-monetary benefits resulting from VE cannot be precisely measured, nevertheless they are substantial. Further improvement in these characteristics benefit both the Government and the contractor. Thus, prior to determining the structure and magnitude of the VE investment, the nature of the overall benefits likely to accrue should first be considered.

C4.3.2. Resources Needed

C4.3.2.1. Dollars. The total investment in a VE program may be viewed from several aspects. One view is to consider that the investment in VE has three components. First are the "indirect" costs of planning and operating a VE program, including such items as training, promotional materials, motivational exercises, etc. The second consists of the cost of generating and reviewing specific VE proposals. However, the success of the DoD VE program is measured by the savings from implemented VE actions. Therefore, the third cost component associated with a VE program is the cost to implement accepted VE proposals. The budget for a VE program must include the funds necessary for implementation to eliminate impediments such as "no money for test" or "no money available to purchase samples." For instance, the VE program may require more money for implementation and test costs than is required for the direct cost of the VE studies. On the other hand, resulting savings may total more than 10 to 20 times the cost of the studies. To take advantage of this potential yield, implementation funds have to be made available.

C4.3.2.2. Personnel (Level of Effort)

C4.3.2.2.1. In addition to a dedicated individual to manage the program, experience in industry and the Department of Defense indicates that a minimum level of effort is at least one full-time value engineer per one hundred (100) design or production personnel. Another reasonable index developed from the experience within DoD and contractor activities is to commit 0.1 percent to 0.5 percent of total annual dollar volume as an initial operating budget for VE. For procuring activities, one full-time value engineer for each 50 employees is reasonable. (These indices are guidelines and should not be considered inflexible requirements.) This ratio may vary considerably depending upon the degree of in-house specification analysis undertaken. The level of effort to be applied also varies with the nature of the VE organization, and the type of operation at the activity; i.e., the percent of design, development, and production; the type of product or services, etc. Also the need for dedicated people may be reduced if there are trained people in the organization who perform VE as an integral part of their job and can be made available for special intensive reviews.

C4.3.2.2.2. Some organizations have applied a novel procedure for providing the funds necessary to sustain a VE program. The VE program is funded at an initial level that management deems a reasonable investment risk. As the actual dollars saved become available, a portion of the savings is channeled into the VE program to replace expended funds. This accounting procedure permits a VE program to sustain itself on a portion of the actual savings that is achieved. The remainder is returned and utilized for other purposes. The process is somewhat similar to DoD operations supported by the stock fund concepts. This arrangement provides a continuing current assessment of the VE program and acts as a strong stimulus to encourage identifiable and verifiable results.

C4.3.3. Rates of Return

C4.3.3.1. The factors used to calculate rate of return will vary in accordance with the way the VE program is organized, and the manner in which indirect costs are allocated. Often, net savings to investment ratios of 15 to 1, or even higher, are shown. Many consider a reasonable return on the VE investment to be 10 to 1. But to be meaningful such claims must include an explanation of the investment base as well as the manner in which the productivity of the VE effort is measured. Productivity is a function of the savings resulting from implemented VE proposals. Productivity can be based on the savings for 1, 3, 5, 10, or more years. Each possibility has its adherents.

C4.3.3.2. Within the Department of Defense, VE savings actions are reported in accordance with DoD Instruction 4245.8, which provides that monetary savings will be calculated for 3 years. The savings for all 3 years (separately identified for each year) are reported in the fiscal year that the action is accepted and implemented.

C4.3.3.3. Similarly, the investment base is also subject to interpretation. For instance, a VE staff of four (a manager, two specialists, and a secretary) might incur direct payroll costs of $125,000 per year. Some might consider this the total investment in VE. Others might wish to include such overhead costs as fringe benefits, taxes, travel, telephone, facilities, etc., which might add another $50,000. Still others might wish to charge the VE program for the time and expenses of others on the VE program. For example, five managers meeting as a VE council for 1.5 hours a month might charge the VE program $10,000 per year. Or, non-VE personnel supporting VE efforts might cost the VE program $200 per day salary plus any other expenses incurred. Thus, a manager who includes all of the expenses necessary to operate a VE, program, might consider a more conservative 5 to 1 net return on investment to be a more realistic goal.

C4.3.3.4. As the program matures, it should be reviewed periodically and a rate of return determined. Knowing the basis for the statistics regarding the program, a manager could then adjust the VE investment as necessary to maintain an adequate return. The experience of others and knowledge of the results achieved by other programs may be used as a guide to determine the initial investment and expected rate of return. But the results attained will determine a manager's subsequent investment decisions. If the investment cost is exceeding the savings or providing a poor rate of return, the program may be overstaffed or for other reasons not be functioning properly. In this case a manager may wish to make whatever adjustments are likely to yield a more productive VE program. On the other hand, an extremely high rate of return may indicate that an increase in investment in VE may provide even greater savings.

C4.4. ORGANIZING THE VE CAPABILITY

C4.4.1. Placement within the Organization

C4.4.1.1. There is no preferred position within the organizational structure for the VE function. The mission of the parent activity greatly affects the type and location of the VE organization. Basic differences exist between development, acquisition, production, reprocurement, and maintenance activities. Some organizations may be

devoted almost entirely to one of the above. But in most cases, there is a combination of activities with which to deal. The structure of the VE organization will vary to correlate with the functions and responsibilities of the activity of which it is a part. For example, a company specializing in research and development on advanced aerospace equipment generally will be heavily engineering oriented. In this instance, the principal focus for VE usually falls within the engineering department. On the other hand, a manufacturing company primarily engaged in the production of standardized military items that are procured in large quantities on a recurring basis tends to concentrate VE effort in the production department. Another company that subcontracts a great portion of the total dollar value of its contracts might well place primary emphasis on VE in the purchasing department. Some large companies, like the Department of Defense, place operating VE elements in several activities such as engineering, purchasing, production, and marketing.

C4.4.2. Categories of Responsibilities

C4.4.2.1. It is usual practice to divide the VE responsibilities into two categories, the coordinating and the operating components. Coordinating tasks are those undertaken to assist those who perform actual VE efforts. Examples of coordinating tasks are overall program control, assignment of savings goals, allocation of resources, determination of priorities, measurement of progress, and development of VE policies and procedures. Operating tasks are those concerned with the direct support or actual performance of VE. Those assigned operating tasks conduct VE studies and generate and present VE proposals (VEPs). Also, they are usually assigned the responsibility for ensuring that a VEP (or a VECP) is carried through to either implementation or rejection. (In some organizations, those performing coordinating tasks share this responsibility.)

C4.2.2.2. The coordinating and operating elements may be vested in one group. This group can be subdivided, formally or informally, to satisfy both sets of duties. When the value studies constitute a variable workload supporting several projects or programs, a centralized VE organizational structure may be the most effective arrangement. Under this "pool" concept, the VE personnel are technically assigned to projects as required while administratively reporting to the central VE group. This type of organization would, for example, permit a single staff group to provide direct support for a number of program or project offices. As the value program matures and its scope expands, it may be desirable to separate the coordinating and operating elements. Also, the size of the parent activity will influence the number of levels and type of structure for the VE element. For example, in a small organization the VE component may be organized as a single element or even as one person, embodying both the coordinating and operating responsibilities. On the other hand, in a

very large organization there may be a number of VE program managers with subordinates, all of whom perform only the coordinating tasks. In addition, there may be a number of operating VE units in each of the major departments of each facility. Although both coordinating and operating tasks are vital for a successful program, the ratio of "doers" to coordinators should always be as large as possible.

C4.5. METHODS OF OPERATION

The VE operating component can be organized any number of ways, depending upon the size, project mix, and structure of the parent organization. In practice, most of the patterns fall into three categories. These methods are not mutually exclusive. Many organizations use them in combinations. Some even use all three at the same activity. The three methods are:

C4.5.1. Multi-Discipline Project Teams. Task force teams of specialists, including full-time value engineers, may be assigned to value engineer specific products. Normally team members represent many disciplines or occupational specialties such as design, production engineering, purchasing, industrial engineering, manufacturing, logistics management, user, etc. The complexity of the study subject and its cost determine the magnitude of the effort undertaken by the project team. The team may work on a full- or part-time basis. Teams have been established for as short a term as two weeks or for as long as six months. This method of organizing the operating component has the advantage of bringing together a number of diverse yet complementary talents that provide a multi-discipline approach to the problem. When the task is completed and the proposed remedies are accepted and implemented, the team is disbanded.

C4.5.2. Project Value Engineers. Using this approach, a value engineer is assigned to a particular project and made responsible for a continuing VE effort from design through production. In this case, one or more value engineers technically competent in the assigned product area is assigned responsibility for ensuring optimum value in the product at every stage in its development. This method of organizing the VE effort has the advantage of providing VE continuity through all design and production decision points. The approach is most useful when projects are of sufficient economic promise to justify assigning value personnel on a full-time basis.

C4.5.3. Procedural Review Points. With this method, a value engineer participates in all decisions at established review points such as design reviews, make-or-buy reviews, systems integration, drawing-release points, etc. The value engineer in this case is responsible for ensuring that value considerations are given proper weight at

each decision point. This approach permits the VE staff to provide coverage for more projects. Although this procedure does not encourage intensive VE studies, in some cases it has been organized in a manner that would subsequently lead to such studies.

C4.6. VE IN THE PROJECT MANAGEMENT OFFICE (PMO)

C4.6.1. Two aspects must be considered when establishing and operating a VE program in a PMO. They are managing the VE effort and performing the actual VE studies. Generally, VE studies must be accomplished at an appropriate level of responsibility (system versus detail) within the organization. If systems engineering is a part of the actual work of the PMO, then VE studies can be accomplished as part of the system-engineering effort. If the PMO is a separate organizational entity from its system-engineering element (as for example, in technical direction and system-engineering contracts), the PMO VE role may be primarily one of management. Managing VE in a PMO would include identifying areas for VE study, arranging for contract incentive clauses, and monitoring the results. It might also include arranging (and possibly managing) VE task forces staffed (or augmented) by personnel temporarily recruited from other sources.

C4.6.2. There are inherent variations in the operation of project offices. To effectively manage VE, each PMO should establish VE objectives, develop a plan for achieving these objectives, and incorporate procedures for measuring progress toward the established objectives. The plan should take into account all the VE resources available to the PMO both contractual and organic. Figure C4.F1. offers three different PMO VE program options. These programs differ primarily in the amount of manpower required. The basic objectives of each option are to reduce costs and meet any assigned VE savings goals without impairing essential performance. Slight variations of these options should fit most PMO situations.

C4.6.3. Within the Department of Defense, most of the procurement dollars are spent by the PMOs that manage major weapon systems. The DoD semi-annual reports, therefore, include statistics on VE accomplishments in each major program in order to emphasize their importance.

C4.7. MOTIVATIONAL CONSIDERATIONS

C4.7.1. Goal Setting

C4.7.1.1. Announcement of an overall VE program savings goal is not likely to stimulate extensive participation in a VE program by subordinate organizations.

Instead, each subordinate activity should accept responsibilities for a specific portion of the overall goal. Collectively, these sub-goals should add up to the total goal. This goal apportioning continues down through the entire organization. Achieving the VE savings goal should be the responsibility of the line organization, not the VE staff. In this way, savings become a line management responsibility. The entire organization becomes committed to achieving the savings targets. Each organizational component has a known specific target against which it can measure its own achievements. The VE goals assigned to an organization are expected to be "reasonable" in that the target is not set so high as to be unattainable, nor so low as to require little effort to meet it. However, the goals are intended to be attainable only by a concerted effort. This provides the impetus for each component to concentrate on projects promising the greatest dollar return per hour of VE effort. To ensure a continuing motivation, previously announced targets should be given renewed emphasis periodically.

Figure C4.F1. Some Program Management Office VE Options

Options	Actions	Manpower	Comments
Option I - Minimum Investment Program.	1. Establish and operate VE reporting procedure. 2. Encourage contractors and subcontractors to submit VECPs (letters by program manager). 3. Publicize and reward achievements.	One person part time, if procurement and technical personnel are made responsible for encouraging contractors to submit VECPs.	Program designed primarily for meeting VE program goals. Requires periodic management review of results obtained and periodic reminders to personnel to continue actions 1 and 2.
Option II - Medium Investment Program.	Actions 1 thru 3, plus: 4. Establish cost target program. 5. Establish procedures to identify areas for VE studies. 6. Assign VE study responsibilities during program reviews, and design reviews. 7. Visit contractors to review VE program progress and encourage VECP submissions.	One person full time, if assignment is primarily coordination asks. If operating tasks are also included, manpower requirement would vary with size of system-engineering group (approx one per 50).	This option is intended to achieve VE through individual efforts as part of overall task. Requires training plan. Should reduce costs beyond goals. Management review of progress again required.
Option III - Maximum Investment Program.	Actions 1 thru 7, plus: 8. Conduct selected VE team or task force efforts on areas of high potential savings (in-house or joint Government/contractor efforts).	Per specific target. 2 to 5 people for 12 to 15 weeks. May be part time, no less than half-day meetings. Full-scale effort (complete analysis of system): 2 to 6 key PMO systems engineers supported by 10 to 30 additional people who could come from external source. Help to manage effort may also be available externally. force may meet for up to 2 months.	More resources applied to high-dollar opportunities. VE opportunity emphasized for both management and operating personnel. Task forces also train, demonstrate benefits, and motivate personnel. Joint contractor Government efforts conserve Government manpower and demonstrate benefits of FAR VE clauses to industry and Government personnel.

C4.7.1.2. One method used to establish a goal is to compute the anticipated cost of the VE program and multiply it by ten. A second method is to assume an average level of cost reduction through VE on the entire product mix. Although the cost of the items studied may be reduced by 20 percent, 30 percent, or even more, the total cost of the entire mix is not likely to be reduced by this amount as an average. A very conservative across-the-board figure of 5 percent (or some other percent) of the total cost might be reasonable for a savings goal. Initial goals set on this basis may be subsequently revised, as appropriate. Some commercial entities report that as much as 20 percent of their net profit after taxes results from their in-house VE program.

C4.7.1.3. Within the Department of Defense, a goal of 0.7 percent of the procurement TOA was set for the Contractor VECP program in 1979. Each Military Department is responsible for allocating this goal among its major purchasing activities. Each DoD Component reports its accomplishments versus the goal semi-annually. In addition to dollar goals, some DoD Components set annual goals for the number of VE actions. This serves as an additional stimulus to the VE program.

C4.7.2. Recognizing Contributors

C4.7.2.1. The purpose of the VE staff is to act as a catalyst for the overall VE savings program. Since VE savings goals are assigned to the line or program management organization, the dollar savings are credited to the element responsible for taking the action. Within the Department of Defense, the element whose budget is affected by the savings action, (usually the element responsible for implementing the proposed change) is responsible for reporting the savings. The reported savings is then credited against the specific VE goal of the reporting element. Current DoD policy is to report all VE savings that result from VE actions taken by personnel of DoD Components or VE actions on existing defense contracts that require Government approval (VECPs).

C4.7.2.2. Official recognition of contributors is vital to realizing the full potential of VE. A DoD manager needs to know which employees enhance the image of an Agency spending the tax dollar wisely. An industry manager wants to know which employees are sufficiently competitive and profit-minded to apply VE resources and methodology most effectively.

C4.7.2.3. The assignment of credit can be more subtle and complex than the direct measurement of VE savings. The system used by management to measure the results achieved by organizational elements participating in the VE program can be developed into a motivational force to encourage implementing VE proposals. For

instance, one large aerospace contractor noted that its Government contracts' staff placed very little emphasis on presenting VECPs to its DoD customers despite the significant profit opportunity that they represented. A study of the problem revealed that the net effect on the marketing group of accepted and implemented VECPs was a reduction in contract sales achievements equivalent to the reduction negotiated in the contract price. To counteract this negative incentive, the Government contracts group is now credited with the sales equivalent to the savings reward earned for a VECP. For example, an accepted $100,060 VECP (with a 50 percent sharing clause) used to result in the sales group losing credit for $100,000 in sales. Now Government sales might be credited with something like $625,000 in sales based on an assumed 8 percent average gross income to sales. This procedure encourages the Government contracts group to strike a proper balance between its marketing efforts on new contracts and VECPs based on profit potential rather than impact on sales dollars.

C4.7.2.4. The Department of Defense has an annual honorary awards program for VE. The awards program is intended to acknowledge those individuals, program managers, organizations, contractors and VE specialists whose VE efforts were exemplary and resulted in substantial savings benefits during a particular fiscal year. Under this program, each DoD Component is encouraged to forward one nominee in each of five categories: DoD program manager, DoD field command or installation, DoD individual, DoD contractor, and VE professional. In addition, each DoD Component may also provide additional awards to its contractors or personnel who merit recognition for lesser, but still significant achievements. For example, one DoD Component provides an award to contractors with approved VECPs of $50,000 or more. Another recognizes individuals who reach savings of $100,000 or more.

C4.8. PROGRAM CONTROL

C4.8.1. Listed below are items of information normally included in a VE program control reporting system within a contractor or Government activity. Not all items would necessarily be reported to top management. Of those that do appear, many would be summarized rather than reported in detail.

C4.8.1.1. Identification of the unit preparing the report.

C4.8.1.2. Date the report was prepared.

C4.8.1.3. Time period covered by the report.

C4.8.1.4. Number of VE proposals approved and implemented during the reporting period, including net DoD savings anticipated.

C4.8.1.5. Number of VE projects currently under study.

C4.8.1.6. Number and dollar savings of VE proposals currently being evaluated.

C4.8.1.7. Breakdown of "age" of proposals under evaluation, (i.e., 0 to 60 days, over 60 days).

C4.8.1.8. Number of personnel spending more than half their time on VE work.

C4.8.1.9. Total cost of VE program, last 12 months.

C4.8.1.10. Ratio of savings to cost of program, last 12 months.

C4.8.2. For DoD Components, semi-annual reports are required in accordance with DoD Directive 4245.8. Additionally, each accepted VE action is to be entered into the appropriate VE database. For supply and service contracts, a DD Form 2333 is to be used to forward the information to the DoD VEDISARS. Construction actions are forwarded to the VE-trieval system.

C4.9. AUDIT SYSTEM

C4.9.1. Program. There are two basic types of audit procedures. First, is the VE program audit, an on-site qualitative evaluation of the VE effort. Program audits can be internal (i.e., within the Department of Defense or within contractor establishments) or a customer audit of supplier VE operations. Regardless of the type, the substance of the audit is the same. It includes an examination of the organization, staffing, procedures, and budgets of the VE elements throughout the organization. The audit team may also verify the validity of reported VE savings. In order to minimize the cost of the VE audit, it is generally integrated into previously established audit functions. The frequency of audits depends upon available manpower resources. Once a year is a reasonable goal, not always achieved in actual practice.

C4.9.2. Savings Actions

C4.9.2.1. A second type of audit procedure is used to validate each reported savings action against the established criteria. In the Department of Defense, estimated savings are reviewed before Component semi-annual reports are submitted. Normally, all reported savings are both supported and validated from records and documentation existing within the reporting organization.

C4.9.2.2. Current guidance for the in-house DoD VE program specifies a comprehensive audit of actions that save $100,000 or over in any one of the three reporting years. Savings below $100,000 a year are given desk reviews and occasionally a very limited field audit. The cognizant auditor for the reporting activity either validates each savings action or provides a signed statement setting forth the reasons for non-validation. Only validated savings are reported. When reporting officials do not concur with an audit non-validation and are unable to settle the dispute at the local level, a copy of the non-validated individual savings action; the auditor's statement; and a rebuttal to audit conclusions are forwarded through channels for review and final decision at a higher headquarters level.

C4.10. SUMMARY

Maintaining an effective VE program requires continuous monitoring and control. The initial investment in VE might be funded at 0.1 percent to 0.5 percent of the organization's budget (or sales for industry). Return on investment may range from a conservative 3 to 1 to a ratio of 10 to 1 or even higher. The results achieved will dictate the nature of the adjustments in the VE investment. The VE functions must be positioned in the organization in such a way as to be able to adequately perform both coordinating and operating functions. VE is generally accomplished in one of three ways:

C4.10.1. Multi-discipline project teams;

C4.10.2. Project-value engineers; and

C4.10.3. Procedural review points, or a combination of these.

C4.10.4. The VE capability in a Program Management Office must complement and provide direct support to those undertaking value studies, as well as coordinate in-house and contractor VE programs. VE goals will be influenced by differences in product mix, VE capability, size of the organization, etc. Broad targets, however, can often be set by:

C4.10.4.1. Multiplying the cost of the VE effort by a target ratio; or

C4.10.4.2. Taking a predetermined percent of the total product dollar volume.

C4.10.5. A reporting system measures progress toward the targets and provides a quantitative measurement of the program. A well-designed reporting system is concise,

responsive, accurate, and timely. Summary reports are employed for higher-level use. The concept of "reporting by exception" is utilized when appropriate. An audit system provides an on-site qualitative measurement of the VE program as well as verification of reported savings. The VE audit should be integrated with existing audit functions to minimize cost. Figure C4.F2. provides a checklist useful to contractors in evaluating their VE program.

Figure C4.F2. Contractor VE Program Checklist

1. Do you set company or division goals for VECP income?

2. Are VECP goals established for line department and program managers?

3. Does top management review VECP income and approve VE operating goals and budgets.

4. Does company top management meet with key customer personnel to agree on VECP goals and processing on major contracts and programs?

5. Do personnel, such as marketing, work on the "team" and do they receive credit for VECPs approved, or are they "penalized" due to reduced credit for reduced contract price?

6. Do your negotiators understand VE clauses in the FAR? Do you request and negotiate for fair terms?

7. Do you place VE sharing provisions in your subcontracts?

8. Is VECP income identified separately by accounting so that (1) Renegotiation Board review is eased, and (2) top management can recognize contribution of VE?

9. Do you assign resources to the development and marketing of specific VECPs?

10. Do you operate in a manner that allows you to minimize time to (1) develop a VECP and (2) obtain internal company approval prior to submittal to the Government?

11. Do you conduct formal VE workshops to expand your in-house capabilities and educate your customer?

12. Do you exploit the benefits of using preliminary VECPs with your customer?

C5. CHAPTER 5

VE METHODOLOGY PART I: GENERATING PROPOSALS

C5.1. INTRODUCTION

A task that is accomplished in a planned and systematic manner is more likely to be productive than one that is unplanned and relies upon undisciplined ingenuity. VE efforts generally follow a variation of the scientific method to ensure a planned purposeful approach. This procedure is termed the VE Job Plan. It was conceived as a group undertaking because it is unlikely that an implemented VE proposal will be the product of the effort of a single individual. This Chapter explains the VE Job Plan as it would be employed in a specific VE study.

C5.2. GROUP DYNAMICS

C5.2.1. The cornerstone of an effective VE effort is the generation of a large number of useful ideas developed into feasible proposals. To accomplish this efficiently, it is common practice to seek and utilize contributions from specialists representing many disciplines and form a team amalgamating their specialties with VE. Those team members who are VE specialists provide motivation and guidance to ensure that the VE Job Plan is followed. The other specialists are used to gain new insight and generate new ideas. They not only contribute their own capabilities but also usually have ready access to additional specialists. Although it is not necessary for all team members to have had previous VE training, it is a desirable goal. Each member of the team contributes a pattern of thinking that is characteristic of his or her specialty and experience. Each member tends to stimulate other team members to contribute their characteristic patterns of thinking. Each can determine and discuss the effect another's idea will have on his or her own area of interest.

C5.2.2. No single phase of the VE Job Plan should be assigned as a secondary responsibility on a part-time basis with the expectation that collectively VE will be accomplished. Experience has proven that a VE effort is most productive when all personnel involved in the team actively participate in all phases of the VE Job Plan.

C5.2.3. The group dynamics of a VE team effort produce benefits which the efforts of one or two individuals can seldom match. Among the prominent benefits are:

C5.2.3.1. More talent is directly applied to the problem.

C5.2.3.2. The scope and depth of the effort is increased.

C5.2.3.3. More efficient use is made of the available time because problem areas are more readily resolved through direct communications.

C5.2.3.4. Team participation provides productive training for those not previously exposed to formal VE training and serves as a refresher course for those with previous VE training.

C5.2.3.5. The synergistic effect of a diverse group working in harmony toward a common objective.

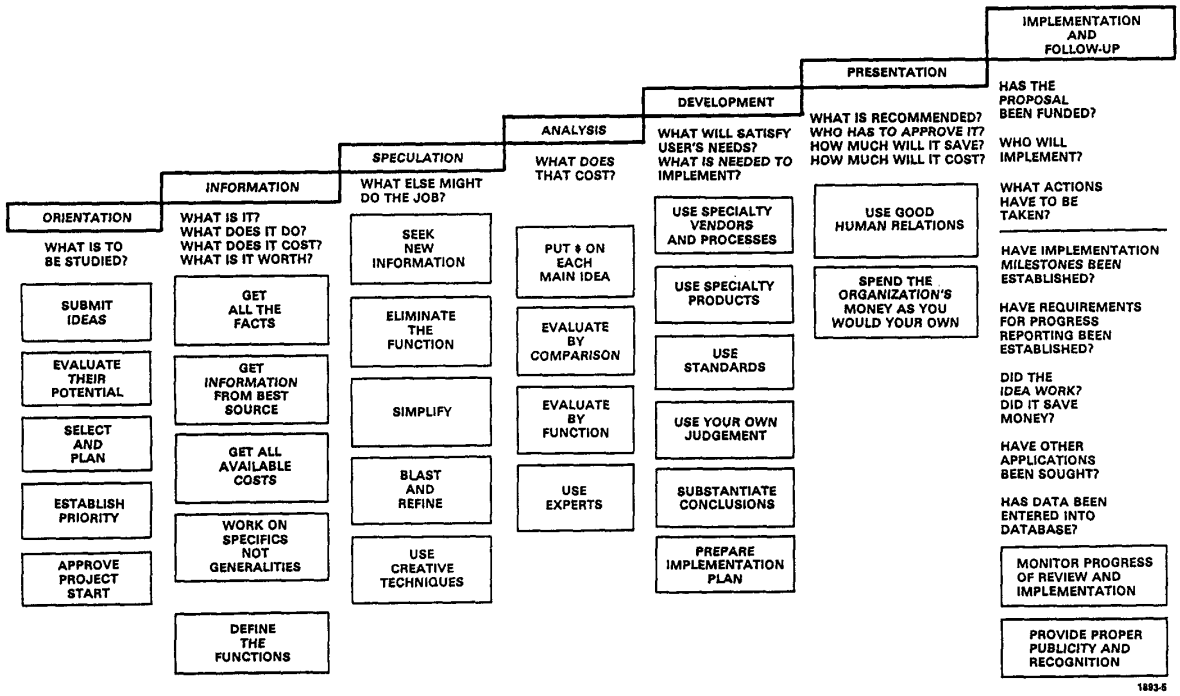
C5.3. THE VE JOB PLAN

C5.3.1. Several versions of the VE Job Plan can be found in current VE literature. Some texts list five phases, others six, and some refer to more. However, the number of phases is less important than the systematic approach implied. This Manual describes a seven-phase VE Job Plan. It encompasses the same fundamentals contained in other VE Job Plans (Figure C5.F1.). Actually, there are no sharp lines of distinction between the phases. They tend to overlap in varying degrees and generally require several iterations through many of the phases of the plan.

C5.3.2. An effective VE effort must include all phases of the Job Plan. However, the proper share of attention given to each phase may differ from one effort to another. The Job Plan represents a concerted effort to furnish the best answers to the following "key question":

What is it?
What does it do?
What must it do?
What does it cost?
What is it worth?
What else might do the job?
What does that cost?
What will satisfy all of the users' needs?
What is needed to implement it?

Figure C5.F1. VE Job Plan Chart



C5.3.3. The remainder of this Chapter is devoted to describing and discussing the essential elements of the first five phases of the Job Plan as they occur in a typical VE effort. The sixth and seventh phases (Presentation and Implementation and Follow-up) is discussed in the next chapter.

C5.4. ORIENTATION PHASE

The selection of VE projects is a management responsibility in the orientation phase. The success of the VE program depends on management exercising its project authority wisely. Most organizations have limited VE resources available for a large number of projects; therefore, project selection should be based on maximizing return (maximum cost reduction) for the total VE investment. Selections should be ranked by dollar value with the most potential for savings being assigned to the product with the highest total cost. In the early stages of the VE program, the selection process may be quite simple, but when the obvious projects are depleted, the need for a systematic project selection procedure develops. Guidelines for the selection of projects may mean little in a specific situation. Due to the wide variety of situations the VE management approach may be different. Since identifying cost function worth relationships is a way to identify VE opportunities, these techniques can also be used to identify preliminary projects. Throughout the selection process one way to help ensure success is to make

sure management is aware of the potential of the VE technique, the capability of VE personnel, and those decisions necessary to fully utilize the available VE resources.

C5.5. INFORMATION PHASE

C5.5.1. The second phase of the VE Job Plan has these objectives:

C5.5.1.1. An understanding of the product being studied.

C5.5.1.2. Determining the essential functions.

C5.5.1.3. Estimating the potential value improvement.

C5.5.2. Types of Data. To acquire an adequate understanding of the subject of the VE effort, the product itself must be studied as well as its general technological area. Data accumulated should include the predicted total cost of ownership; the present configuration the quality, reliability, and maintainability attributes; the quantity involved; and the development history. Included among the required general information are the current applicable state-of-the-art sources of supply, processes, and procedures, and a listing of individuals whose specialized knowledge might prove useful during the study. It is most important to seek qualified sources to obtain facts, not opinions. All relevent information is important. The data must be supported, either by appropriate documents, or by reference to their source.

C5.5.3. Functional Analysis

C5.5.3.1. One of the most important elements of the VE Job Plan is the description of the function of an item. It is the foundation upon which the entire effort is based. If incorrect, it can easily mislead the entire effort. However, it is not unusual for the original functional description to be modified or replaced by a better version as additional insight is gained during the VE study. One trap to avoid is the temptation to base the description of function on the observed characteristics of the existing design. Do not assume that all of the characteristics of the present design are required. It is quite possible that not all of the functions are actually needed to satisfy the user's needs.

C5.5.3.2. The primary objective of functional analysis is to facilitate the discovery of alternative means of achieving the desired performance. It is also one way to identify areas offering likely opportunities for value improvement. Functional descriptions in the simplest specific terms offer the greatest potential for the development of alternatives. This simplicity of expression is accomplished by using only two words: a verb and a noun. The reasons for this restriction in the functional description are:

C5.5.3.2.1. To focus on function rather than the item.

C5.5.3.2.2. To avoid confusion from combining functions.

C5.5.3.2.3. To encourage creativity.

C5.5.3.2.4. To free the mind from specific configurations.

C5.5.3.2.5. To reveal unnecessary costs.

C5.5.3.2.6. To facilitate comparison.

C5.5.3.3. The two word function description results in a clear and concise definition. The verb should be an active verb, e.g., adjust, decrease, hold, etc., to describe an action, occurrence or state of being of the item under study in such a way as to facilitate comparison. The noun should be quantifiable, e.g., current, pressure, weight, etc., for the same reason.

C5.5.3.4. Another characteristic of the function description that is important is the level of abstraction. The level of abstraction may be explored by starting with the verb and noun that comes to mind most readily and asking the questions "how" and "why" and answering them with function statements. Asking "how" lowers the level of abstraction and asking "why" raises the level, making the function description more general. In practice, the desired level is one that makes possible the largest number of feasible alternatives. Since the higher levels are more inclusive, affording more opportunities, what is desired is the highest level that includes applicable, achievable alternatives. A practical limit to the "why" direction is the highest level at which the practitioner is able to make changes.

C5.5.3.5. If the level selected is too low, alternatives may be restricted to those resembling the existing design. If the level is too high, it may suggest alternatives that are beyond the scope of effort and obscure achievable ones.

C5.5.3.6. The function descriptions for the various parts or features of a product or procedure may be joined to form a diagram that shows the dependency relationship of the functions to each other. The diagram is constructed using the "how" and "why" logic. The apportioning of the total cost to each of the functions makes the diagram, in effect, a function-cost model that facilitates targeting of the VE effort.

C5.5.3.7. Functions are categorized as either basic or secondary. An item's basic function is the function(s) required to provide the essential utility needed by the user. Secondary functions play an enabling role. They merely make the basic function(s) achievable. Secondary functions are considered to make no direct contribution to worth, but do add directly to cost. Consequently, value improvement efforts aim to minimize the number of secondary functions.

C5.5.3.8. The worth of each basic function must be established in order to:

C5.5.3.8.1. Determine whether or not the VE effort will be worthwhile.

C5.5.3.8.2. Obtain a reference point from which the cost of alternatives can be compared.

C5.5.3.8.3. Formulate a target cost or goal, to provide a psychological incentive to discourage a premature relaxation of the VE effort.

C5.5.3.9. When analyzing the functions of a large system, it is common practice to first divide it into major areas. Each area may then be approached:

C5.5.3.9.1. As an element in the next larger assembly;

C5.5.3.9.2. In terms of its own components; or

C5.5.3.9.3. As an identifiable, nondivisible item. The relative position that an item occupies in a system or total assembly is called its level of indenture. Systems usually have many such levels. The function of a subassembly may be considered nonessential (secondary) in the light of the basic function of the assembly. However, when studying the subassembly by itself, one assumes its function to be essential (basic). The rule for the functional analysis of a system is to work from the top down. As each level of indenture is reviewed, it is temporarily considered as the top level. If the VE objectives are not achieved at the top level, the next lower level of indenture is studied, and so on through to the lowest level.

C5.5.3.10. After selecting an item, the functional analysis proceeds as follows:

C5.5.3.10.1. Divide the item into functional areas suitable for further analysis.

C5.5.3.10.2. Continue the breakdown for at least three levels of indenture.

C5.5.3.10.3. Working from the top down, determine the function of each element of the breakdown structure.

C5.5.3.10.4. Determine whether each function is basic or secondary in relation to the function of the next higher level of the analysis.

C5.5.3.10.5. Assign a worth of "O" to secondary functions.

C5.5.3.10.6. After the basic functions have been described in their simplest terms define the dimensions of the noun. For example, if the function is determined to be "apply force," the units of "force" have to be quantitatively stated; i.e., 10 lbs.

C5.5.3.10.7. Estimate the worth of the essential function(s). That is the cost of performing the essential function(s) in the simplest, most fundamental way.

C5.5.3.10.8. Estimate the present cost of each element of the breakdown.

C5.5.3.10.9. Using the information derived in the items above, identify areas having excessively low ratios of worth to cost.

C5.5.4. Economic Analysis

C5.5.4.1. All VE efforts include some type of economic analysis. The objective largely determines the type and degree of economic analysis undertaken. Economic analysis is used to identify areas of VE opportunity and provide a monetary base from which the economic impact of the effort can be determined. The prerequisite for any economic analysis is reliable and appropriate cost data. At the start of a VE effort, the available cost data may not be sufficiently accurate, sufficiently detailed, or arranged in a manner that facilitates its use. Consequently, the VE effort must include the services of one or more individuals who are skilled in estimating, developing, and analyzing cost data. The cost of the original or present method of performing the function is determined or estimated as carefully and precisely as

possible. The accuracy of a cost estimate is dependent upon a number of factors such as:

C5.5.4.1.1. The "maturity" of the item.

C5.5.4.1.2. The availability of detailed specifications and drawings.

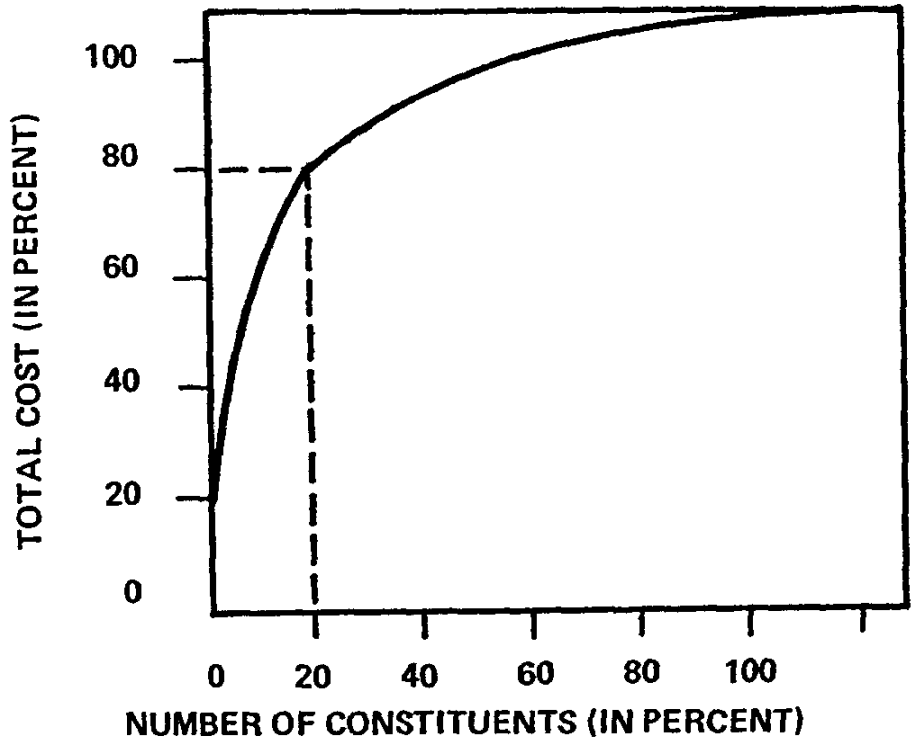
C5.5.4.1.3. The availability of historical cost data.

C5.5.4.1.4. The time available for preparing the estimate.

For instance, estimates of the cost of items in the conceptual stage are not as precise as those based on completed engineering drawings. Even when drawings exist, the estimate for something that has never been produced is likely to be less accurate than something that has.

C5.5.4.2. When structured in a manner that permits identification of high-cost elements, cost data aid in determining the priority of effort within individual studies. High-cost areas may be indicative of poor value, and therefore are prime candidates for initial investigation. Usually costs are distributed in accordance with Pareto's Law; i.e., a few areas, "the significant few," (generally 20 percent or less) represent most (80 percent or more) of the cost. Conversely, 80 percent of the items, "the insignificant many," represent only 20 percent of total costs. This relationship is illustrated in Figure C5.F2.

Figure C5.F2. Pareto's Law of Distribution



C5.5.4.3. One of the most useful economic analysis tools for VE is the cost model, which is an expression of the distribution of costs associated with a specific VE effort. Cost models range from those that attempt to portray a breakdown of total cost to those that include only one area of cost, such as production cost. The extent of the coverage of a cost model is determined by the objective of the VE effort. One form of the cost model is a graphic presentation that is structured similar to an organization chart. Normally a cost model consists only of those cost elements that can be directly affected by VE actions. Dollars already spent ("sunk cost") are usually set apart because they cannot be reduced by the output of a VE effort. Cost elements may be thought of as unit building blocks that can be combined to equal the total cost of the subject of the study. Ideally, cost elements are assigned to each level of indenture within the cost model. For example, if a handbook or manual is the item being studied, costs are assigned to each portion that has been separately identified. Alternatively, it may be desirable to prepare an overall cost model for the manual and then apportion it among the lower levels of indenture.

C5.5.4.4. As a VE study progresses to completion, the cost model is refined. Target costs may be added to the cost model (see Figure C5.F3.) or the entire structure of the cost model may be altered as a result of new information or new insight regarding VE opportunities. The final model may include savings developed during the VE effort as progress is made toward achieving the targets.

C5.5.4.5. Cost models are used in a VE effort to:

C5.5.4.5.1. Determine the economic feasibility of a VE study. A cost model highlights the potential for economic improvement. It displays current costs together with target costs. Combined with an estimate of the resources (man-hours, skills, money, etc.), it is a valuable tool for determining the potential return on investment of the VE study.

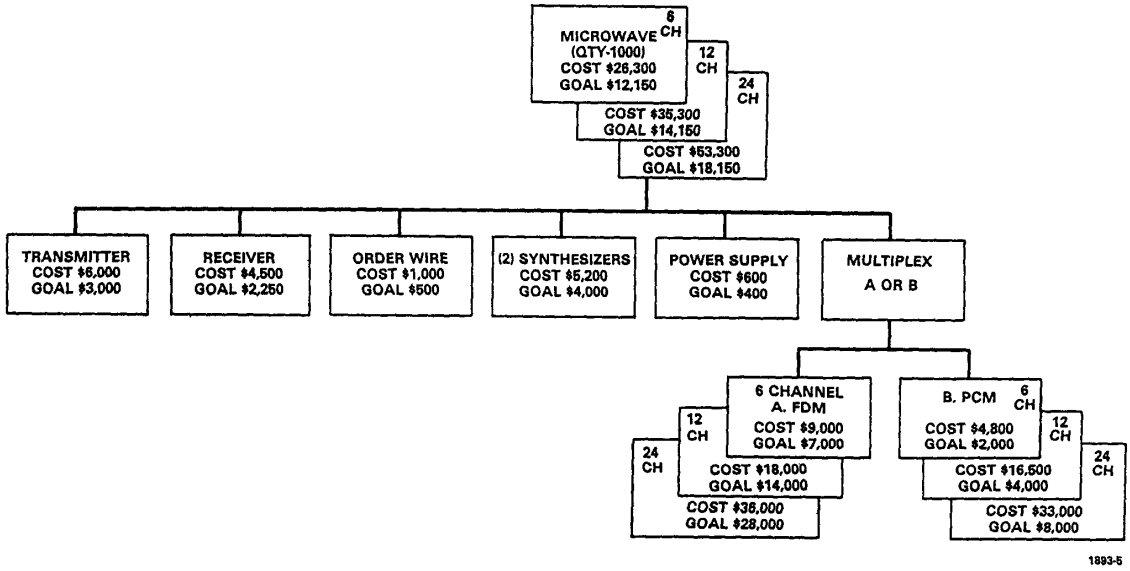
C5.5.4.5.2. Evaluate the necessity for redirecting the effort. The cost model is revised during the VE study to display progress toward the targets. Continued awareness of this progress provides the insight necessary to redirect the study, if necessary, toward more profitable areas in time to gain maximum benefits.

C5.5.4.5.3. Extend benefits to other items. Certain functional elements represented on the cost model of a particular item or system may be similar to those of another item or system. Recognition of this similarity can suggest other value improvement opportunities that might otherwise remain unnoticed.

C5.5.4.5.4. Determine the net savings opportunity. A comparison of the potential savings displayed in the final cost model with the investment required to implement the VE proposals helps determine the net potential savings and the potential return on investment.

C5.5.4.5.5. Review the results. A cost model will highlight areas where the opportunity for economic improvement may not have been fully exploited. Further investigation may reveal the advisability of suggesting corrective management actions to overcome such deficiencies as insufficient resources applied, unexplored opportunities due to lack of time, resistance to change, etc.

Figure C5.F3. Cost/Value Target Model (Functional Elements of Tactical Microwave Equipment)



C5.5.5. Cost Analysis

C5.5.5.1. The first step in a cost analysis is to determine the total cost of an item. There have been cases where the simple act of determining costs has suggested the means and stimulated the necessary action to reduce them. However, the more usual approach is to divide the total cost into successively lower levels of cost indenture to facilitate analysis according to specific cost bases. The most frequently used bases are as follows:

C5.5.5.1.1. Cost elements. The total cost is separated into its constituent elements such as labor, materials, purchased items, overhead, etc. Labor costs are further broken down into set-up and run costs. These cost elements are then compared to the total and to one another, and sometimes to corresponding elements for something similar. The purpose is to identify costs that appear to be excessive.

C5.5.5.1.2. Cost increments. Careful examination of the incremental costs of processing something often uncovers an opportunity for further analysis. Often a large increment of cost is required to provide a small additional margin of performance or benefit. This marginal analysis can be used to identify possible over specification.

C5.5.5.1.3. Cost per pound. Comparison of the cost per pound of like items at similar stages of completion may provide hints for areas to be studied.

C5.5.5.1.4. Cost per dimension. Items such as cable, wire, tanks, and honey-combed sheets are usually described by dimension rather than by weight. Cost per length, per area, or per volume are standard measures by which many things are bought. Cost per dimension of similar things can be compared for the purpose of suggesting alternatives.

C5.5.5.1.5. Cost per property. Comparative analyses of costs per specific property often reveal high-cost areas and suggest lower-cost alternatives. For example, the cost for a given conductance in aluminum compared to the cost for the same conductance in copper may lead to a cost reduction by changing from one material to another.

C5.6. SPECULATION PHASE

C5.6.1. The purpose of this phase is to formulate alternative ways of accomplishing the essential functions. This effort begins upon completion of the orientation and information phases and the existence of function, cost and worth determinations. Four of the techniques used to help answer the question, "What else will do?" are:

C5.6.1.1. Simple Comparison. A thorough search for other things that have at least one significant characteristic similar to the subject of the study.

C5.6.1.2. Comparison of Function. A creative session in which new or unusual contributions of known things or processes are combined and rearranged to provide different ways of achieving the function.

C5.6.1.3. Scientific Factors. A search for other scientific disciplines capable of performing the same basic function. This involves contributions from specialists in disciplines not utilized in the original design. An industry specializing in some unique technique often can make a substantial, contribution when called upon for assistance. For example, a cast motor support housing may be replaced by a welded wire form with a totally different material and configuration or hybrid circuits may be replaced by large scale integrated ones.

C5.6.1.4. Blast, Create, and Refine. Blast to get off the beaten path. Create by reaching for an unusual idea, for another approach. Refine by strengthening and expanding ideas that suggest a different way to perform the function.

C5.6.2. Creative problem-solving techniques are used to discover alternatives that will provide essential function(s) at the lowest possible cost. There are several formal idea-stimulation exercises that may be used during this phase of the VE study. All seek a great number of ideas. The greater the number of ideas conceived, the more likely that among them will be something that will eventually lead to better value. Judgment as to the practicality of an idea is deferred to a later stage. Departure from ordinary patterns, typical solutions, and habitual methods is encouraged, because it may be the new, fresh, radically different approach that leads to a better value solution.

C5.6.3. Creativity is the development of ideas new to the individual. Idea stimulation techniques encourage the generation of creative solutions. Everyone possesses some degree of innate creative ability that can be improved through training and practice. The application of creative techniques to problem solving follows a step-by-step sequence. Innovation or creation is not always the result of conscious, or even logical, effort. However, this discussion will be confined to some of the typical ideation exercises undertaken during a VE effort. The ground rules for creative idea generation may be summarized as follows:[3]

C5.6.3.1. Do not attempt to generate new ideas and to judge them at the same time. Separate these aspects by time, by place, and by different personnel if possible.

C5.6.3.2. Generate a large quantity of possible solutions. Multiply the number of ideas produced in the first rush of thinking by 5 or by 10, to set a goal for the desired quantity.

C5.6.3.3. Seek a wide variety of solutions that represent a broad spectrum of attacks upon the problem.

C5.6.3.4. Watch for opportunities to combine or improve ideas as they are generated.

C5.6.3.5. Before closing the book on possible solutions, allow time for subconscious reflection on the problem.

C5.6.4. There are two general categories of creative techniques used during VE efforts. The first is free association techniques. Examples of free association techniques are:

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[3] DoD Joint Course Book, "Principles and Applications of Value Engineering, Army Management Engineering Training Agency," Rock Island, Illnois 61201, page 2-5.

C5.6.4.1. Brainstorming[4] - a problem-solving conference method that is based upon the stimulation of one person's mind by another's idea. An average brainstorming session consists of a group of people spontaneously producing ideas designed to solve a particular problem. During this session, no attempt whatsoever is made to judge or evaluate the ideas. Evaluation and development of the ideas into practical solutions takes place after the brainstorming session has ended.

C5.6.4.2. Synectics[5] - a problem-solving technique that permits a diverse group to gain unusual and unique insights through the use of the metaphor. Specific psychological mechanisms are employed to develop unusual analogies to a specific problem. Development of these analogies subsequently leads to new and novel solutions.

C5.6.5. The second category is organized techniques. A logical step-by-step approach is followed to generate ideas, one or more of which may provide the solution to the problem at hand. These organized techniques are:

C5.6.5.1. Checklist - an accumulation of idea clues, useful for the subject under consideration. The objective is to obtain a number of ideas for further follow-up and development. The checklist is a common aid in the search for new ideas. Checklists range in type from the specialized to the extremely generalized. Figure C5.F4. is an example of a specialized checklist used in VE. Although checklists may aid in the development of new ideas and remind the user of essential steps in a particular process, they may also restrict thinking.

C5.6.5.2. Attribute Listing - the first step is to list all of the various characteristics of an object. The second step is to change or modify these characteristics. Using this technique, new combinations of characteristics (attributes) may be brought together that will better fufill some existing need. As an example, consider one type of wooden-handle screw-driver that was common a few years ago. Each attribute could be changed as follows:

C5.6.5.2.1. Round shank changed to hex shank so wrench could be used to increase torque.

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[4] Osborn, Alex F., "Applied Imagination," Charles Scribner's and Sons, New York, New York, 1963.

[5] Gordon William J. J., "Synectics," Harper & Brothers, New York, New York, 1961.

C5.6.5.2.2. Wooden handle replaced by molded plastic handle to cut down breakage and danger from electric shock.

C5.6.5.2.3. End modified to fit all kinds of screws.

C5.6.5.2.4. Push, pneumatic, or electric power.

C5.7. ANALYSIS PHASE

C5.7.1. The purpose of this step is to select for further analysis and refinement the most promising of the alternatives generated during the speculation phase. During speculation, there is a conscious effort to defer judgement so that the creative process would not be inhibited. During the analysis phase the ideas are subjected to a preliminary screening to identify those that satisfy the following criteria:

C5.7.1.1. Will the idea work?

C5.7.1.2. Is it less costly than the present design?

C5.7.1.3. Is it feasible to implement?

C5.7.1.4. Will it satisfy the user's needs?

C5.7.1.5. If the answer to any of the above is "no," can the idea be modified or combined with another to give a "yes" answer?

C5.7.2. The ideas that survive the initial screening are then rated according to their relative ability to satisfy the above criteria and their advantages and disadvantages are also noted. Preliminary cost estimates are then developed for those ideas that appear technically and economically most promising. These preliminary cost estimates are based on the same quantities as were the costs for the present design. Likely implementation costs and the impact on total ownership costs are also considered. Following these preliminary estimates, one or more of the ideas with significant savings potential are selected for further detailed analysis. However, if relative cost differences among several alternatives are not decisive at this point, they all may be analyzed further.

C5.8. DEVELOPMENT PHASE

C5.8.1. In this phase, the alternatives that have survived the selection process are developed into firm recommendations, called VEPs. This portion of the effort includes developing detailed technical and economic data. The proposal should include not only a before and after, but also its implementation plan and the anticipated impact on logistics aspects and total costs. This phase is also devoted to assuring that the VEP satisfies all of the user's needs. For hardware projects a checklist such as the following is often helpful:

C5.8.1.1. Performance requirements.

C5.8.1.2. Quality requirements.

C5.8.1.3. Reliability requirements.

C5.8.1.4. System compatibility.

C5.8.1.5. Safety requirements.

C5.8.1.6. Maintenance considerations.

C5.8.1.7. Logistics support evaluation.

C5.8.2. The VEP should include a discussion satisfying any objections likely to be raised concerning any aspect of the proposal. Conferences with specialists are often most helpful in overcoming anticipated objections in advance. If a technical characteristic of an alternative is either unacceptable or marginal, the alternative is modified to correct the deficiency, whenever possible. If it is not possible to overcome the deficiency, another alternative is selected for development. Of the technically feasible alternatives remaining, the lowest-cost one is selected for the detailed development of technical and economic data. In the event that more than one alternative appears to offer equivalent savings potential, the details of each continue to be developed.

C5.8.3. In some instances proof of the technical acceptability of a concept can only be demonstrated by extensive testing. Such extensive testing is not usually a part of the typical VE effort. However, limited tests are occasionally conducted to demonstrate the feasibility of a concept. This phase also includes determining the type, probable duration, and cost of any test program that may ultimately be required to prove the acceptability of a proposed alternative.

C5.8.4. The completed proposal should include an accurate description of the changes as well as the cost impact and savings potential. Cost estimates should be of sufficient accuracy to ensure the validity of the savings potential calculation. The proposal must indicate that the proposed savings will be greater than the cost to implement it. All costs involved in making a change must be included. In some cases, such as a contractor-originated VECP submitted to the DoD both the originator and the responding agency may incur costs if the proposal is implemented. For the originating organization, these costs may include:

C5.8.4.1. New tools, jigs, or fixtures.

C5.8.4.2. Additional materials.

C5.8.4.3. New assembly instructions.

C5.8.4.4. Changes to plant layouts and assembly methods.

C5.8.4.5. Revisions to test and/or inspection procedures.

C5.8.4.6. Re-training assembly, test, or inspection personnel.

C5.8.4.7. Re-working parts or assemblies to make them compatible with the new design.

C5.8.4.8. Cost of tests for feasibility.

C5.8.5. Other costs not normally incurred by the originating activity, but that should be considered include:

C5.8.5.1. Technical and economic evaluation of proposals by cognizant personnel.

C5.8.5.2. Prototypes.

C5.8.5.3. Testing the proposed change including laboratory, firing range, and missile-range charges.

C5.8.5.4. Additional GFE that must be provided.

C5.8.5.5. If applicable, retrofit kits (used to change design of equipment already in field use).

C5.8.5.6. Installation and testing of retrofit kits.

C5.8.5.7. Changes to engineering drawings and manuals.

C5.8.5.8. Training Government personnel to operate and maintain the new item.

C5.8.5.9. Obtaining new and deleting obsolete Federal stock numbers.

C5.8.5.10. "Paper work" associated with adding or subtracting items from the Government supply system.

C5.8.5.11. Maintaining new parts inventory in the supply system (warehousing).

C5.8.5.12. Purging the supply system of parts made obsolete by the change.

C5.8.5.13. Changing the contract work statements and specifications to permit implementation of the proposal.

C5.8.6. It is not always possible to determine the precise cost to the Government of certain elements of a change. For example, it is difficult to obtain the actual cost of revising, printing, and issuing a page of a maintenance manual. Nevertheless, this is a recognized item of cost, because the manual must be changed if the configuration of the item is changed. It is common practice to utilize a schedule of surcharges to cover areas of cost that defy precise determination. Such a schedule is usually based on the average of data obtained from various sources.

C5.8.7. The final cost estimate should be compared with the functional worth determined during the information phase. If the difference is significant, it may be desirable to continue the VE effort to develop further value improvements.

C5.8.8. If more than one alternative offers a valid savings potential, it is common to recommend all of them. One becomes the primary recommendation and the others are alternative recommendations usually presented in decreasing order of savings potential.

C5.9. SUMMARY

C5.9.1. VE utilizes a number of techniques that are specifically designed to assist in the identification of value problems, the generation of ideas that suggest solutions, the analysis of these for feasibility, and finally the development of practical solutions. There is no specific combination of these techniques that may be prescribed for all VE

effort, nor is there a predetermined degree to which each is utilized. The selection of specific techniques and the depth to which they are used is primarily a matter of judgment and varies according to the complexity of the subject under study.

C5.9.2. The VE Job Plan is the framework upon which a successful VE effort is built. When utilized in its entirety and in proper sequence, it ensures a systematic approach to the identification and capture of a value opportunity. The VE Job Plan first provides for a thorough understanding of the subject under study, including a quantitative identification of the nature and worth of its functional requirements. Uninhibited creative effort is then applied to suggest alternative approaches to achieve all functions needed by the user. A series of evaluations then selects and develops the alternative offering the best opportunity for value improvement.

Figure C5.F4. VALUE ENGINEERING CHECKLIST

Specification Review

(1) Have the customer's specifications been critically examined to see whether they ask for more than is needed?

(2) Has the cost of any excessive design features been defined for its effect on production as well as on the R&D program?

(3) Has the cost effect of contract-required excessive specifications been discussed with the customer?

(4) Has the customer identified the target cost for each basic specifications?

(5) What subassemblies have been designed in the early model to represent anticipated new devices that are intended to be used in eventual production?

(6) Where is the written description of the logic supporting the design and its anticipated producibility?

(7) Have the significant "functions" necessary for essential performance been defined (a verb and a noun)?

(8) Do the reasons for any failures to acheive test, schedule, quality or pricing goals represent technology limitatons and require a reexamination of the original objectives?

General Design

(1) Does the design give the customer what he requires and no more?

(2) Could costs be radically reduced by a reduction of performance, reliability, and/or maintainability to the minimum specified?

(3) Could cost be radically reduced by a reduction of resistance to high temperature, shock, vibration, or other environments to the minimum specified?

(4) Have circumstances changed (changes in concept or specifications, progress in the art, development of new components or processes) so that the design include unnecessary or expensive circuitry parts or processes?

(5) Have unnecessarily high-cost items been included as a result of their availability when the breadboard or model was constructed?

(6) Can any variable devices such as potentiometers included for breadboard or model-operational-adjustment be changed now to fixed component parts or semi-adjustable design?

(7) Are proposed cost savings for this VE change still valid when analyzed over the systems life cycle?

(8) Does a failure modes and effects analysis (FMEA) substantiate this improvement?

Figure C5.F4. VALUE ENGINEERING CHECKLIST, Continued

Production Cost

(1) Are the quantities to be built on this order known? Are the estimated quantities to be built on future orders known? Have these factors been considered in the design decisions?

(2) Will tooling costs be in line with present and anticipated production?

(3) What is the estimated cost of the design in production?

Electronic Design

(1) Does the design represent optimum electrical simplicity?

(2) Is circuitry overly complex or conservative?

(3) Have standard "preferred circuits" been reviewed to see how many can be used beneficially?

(4) Has the field of commercially available packaged circuits, power supplies, etc. been reviewed against requirements?

(5) Can circuitry be eliminated by having one circuit do the job of two or more?

(6) When specifying special component parts, have potential vendors been consulted for alternatives or modifications that would hold costs down?

(7) Have all high-cost components such as transistors, semiconductor diode magnetic and high-power devices, motors, gear trains and decoders been examined to determine whether lower-cost substitutions can be made?

(8) Are the components the lowest cost meeting the design requirement?

(9) Can any electrical tolerance be liberalized to allow specification of lower-cost parts?

(10) Have nearly identical parts been made identical to gain the advantage of quantity buying or manufacture?

(11) Does the selected circuitry exploit the latest advances in integrated circuit design and production?

Mechanical Design

(1) Does the design represent optimum mechanical simplicity?

(2) Is every part absolutely necessary? Can any part be eliminated or combined with another part to reduce total number of parts and cost?

(3) When specifying special parts, have potential vendors been consulted for alternatives or modifications that would hold costs down?

(4) Are mechanical tolerances within the limits of normal shop practice?

(5) Are the surface finishes the coarsest that will do the job?

(6) Are the fabrication processes the lowest cost meeting the design requirements?

(7) Have nearly identical parts been made identical to gain the advantage of quantity buying or manufacture?

(8) Are the materials the lowest cost meeting the design requirements?

(9) Does the combination of material and protective finish specified result in the lowest-cost combination?

Figure C5.F4. VALUE ENGINEERING CHECKLIST, Continued

(10) Has relative workability of materials been considered?

(11) Have standard alloys, grades, and sizes of stock been specified whenever possible?

(12) Can the design be altered in any respect to avoid the use of nonstandard tooling?

(13) Does the layout for sheet-metal parts permit direct conversion to automatic sheet-metal machinery?

(14) Can the design be modified to use the same tooling for right and left hand or similar parts?

(15) Are drawings for fabrication of parts that are similar to parts already produced cross-referenced so available tooling can be used?

(16) Can the design be altered to avoid unnecessary handling and processing resulting from such things as riveting and spot welding on the same subassembly part?

(17) Does CAD expression permit direct conversion to CAM?

(18) Are casting bosses of adequate size, considering the large tolerance in casting dimensions?

(19) Do standard drawing practices proposed by developer lead to optimum statistical fit?

(20) Is impregnation of castings called out when it would aid processing? (Castings should be impregnated after machining if they are to be electroplated. This impregnation prevents absorption of plating acids or salts. Castings should also be impregnated if they are to hold liquids or gases under pressure.)

(21) Have engineering and factory specialists been consulted for castings, forgings, weldments, heat treatment, and other specialties?

(22) Have standard sizes, grades, and alloys of fasteners been specified whenever possible?

(23) Are all manual welding operations specified absolutely necessary? Can furnace brazing be substituted?

(24) Are the assembly processes the lowest cost meeting the design requirements?

(25) Has adequate clearance between parts been provided to allow for easy assembly? (Parts have become smaller but hands have not.)

(26) Are markings adequate to guide the assembly processes?

(27) Have the engineering and factory specialists been consulted on any unusual assembly problems?

(28) Has datum-line rather than multiple-surface dimensioning been used on all drawings?

(29) Can any four-place dimension be changed to a three-place dimension?

(30) Can any three-place dimension be changed to a two-place dimension?

(31) Can heat treating after forming sheet-metal parts be eliminated by change of design or material to avoid straightening problems?

(32) Is all masking from finishing materials (such as plating solutions and paint) necessary?

(33) Have the parts been segregated into machine families for efficient fabrication?

Standardization

(1) Has the design been coordinated with similar designs, circuits, parts, or components to get optimum benefit from standardization and past experience?

(2) Are the standard circuits, standard components and standard hardware the lowest-cost standards that will supply the minimum-required characteristics?

(3) Can the use of each nonstandard part of circuit be adequately justified?

Figure C5.F4. VALUE ENGINEERING CHECKLIST, Continued

(4) Can any new nonstandard part be replaced by a nonstandard part that has already been approved?

(5) Do control drawings leave no question that a vendor standard part is being specified when such is intended?

(6) Has standardization been carried too far so the cost of excess function is greater than the gains resulting from high quantity?

Maintainability

(1) Is each assembly self-supporting in the desirable position or positions for easy maintenance?

(2) Can assemblies be laid on a bench in any position without damaging components?

(3) Can the assembly be repaired using available tools and test equipment?

(4) Has the cost of changes to technical manuals and drawings been evaluated?

(5) Can the assembly now be repaired at the next maintenance level?

(6) Has the built-in-test (BIT) capability been optimized?

(7) Have maintenance practices, procedure and equipment received adequate attention during product design?

Testing

(1) Are the test processes the lowest cost meeting the design requirements?

(2) Can any test specification be eliminated or relaxed?

(3) Have interacting controls been eliminated or the adjustments specified in such a manner that the lowest-cost factory-test personnel can easily align the circuit?

(4) Is the system compatible with the requirements for checkout in the factory -- if not as a complete system, then in large subsystem segments?

(5) Have the test-process experts been consulted for alternatives that would keep their costs down?

Subcontract

(1) Has the field of commercially available packaged units, sub-assemblies, and circuits been thoroughly reviewed to be sure there are no standard vendor items that will do the job?

(2) Is desired cost control adequately emphasized in subcontract specification?

(3) Have specifications for subcontract items been reviewed against the check list to be sure they are not overspecified?

(4) Have suggestions been invited from prospective suppliers regarding possible value improvements?

C6. CHAPTER 6

VE METHODOLOGY PART II: MARKETING PROPOSALS

C6.1. INTRODUCTION

A VEP or VECP is a challenge to the status quo of any organization. It is a recommendation for change developed through a team effort and its adoption is dependent upon another team effort. The success of VE action is measured by the savings achieved from implemented proposals. Regardless of the effort invested and the merits of the proposal, the net benefit is zero if the proposals are not implemented. Marketing a proposal and subsequently guiding it to implementation often requires more effort than its actual generation. This Chapter reviews some principles and practices that have been successfully used to facilitate the implementation of VEPs.

C6.2. PRESENTATION PHASE

C6.2.1. The concluding phase of the VE Job Plan includes the preparation and presentation of the proposal to those having approval authority. This phase also includes:

C6.2.1.1. Preparing a plan for implementation.

C6.2.1.2. Obtaining a decision regarding disposition of the proposal.

C6.2.1.3. Assisting as needed in the implementation actions.

C6.2.1.4. Preparing a final report, if appropriate.

C6.2.2. Early in the planning stages, the actual decision makers should be identified and the procedures by which proposals are reviewed, approved, and implemented should be determined. This action is essential to ensure proper consideration of VE proposals and timely incorporation of changes. When presented to the appropriate authority, the proposal should be self-explanatory and leave no doubt concerning its justification. Only factual and relevant information is included. All anticipated technical and economic variations from the existing design must be described. Including supporting data such as test results, examples of previous successful applications, etc., helps convince the reviewer of the merit of the proposal. Figure C6.F1. is a sample VEP format. The following checklist represents the minimum information usually included in a VEP:

C6.2.2.1. Identity of the project.

C6.2.2.2. Before and after descriptions.

C6.2.2.3. Cost of current design.

C6.2.2.4. Cost of proposed design.

C6.2.2.5. Quantity basis for costs.

C6.2.2.6. Implementation cost.

C6.2.2.7. Potential savings.

C6.2.2.8. Necessary actions for implementation.

C6.2.2.9. Suggested implementation schedule.

C6.2.3. Management, responsible for review and approval, must base their judgment on the documentation submitted with a proposal. The proposal and supporting documentation should contain all the data the reviewer will need to reach a decision. Top management is primarily concerned with net benefit and disposition. A manager may either be competent in the areas affected by the proposal or may rely on the advice of specialists. In either case, completely documented proposals are far more likely to be implemented. Generally proposals should contain sufficient discussion to ensure the reviewer that:

C6.2.3.1. Item/system performance is not adversely affected.

C6.2.3.2. Supporting technical information is complete and accurate.

C6.2.3.3. Potential savings are based on valid cost analyses.

C6.2.3.4. The change is feasible (with an adequate qualification test or certification that a qualification test is not required. If necessary, include suggested arrangements for a qualification test as a contingency for acceptance).

Failure to provide adequate proposal documentation is a major cause of proposal rejection. One analysis of rejected proposals concluded that approximately 40 percent of the rejections were due to incomplete or inadequate technical or cost information. It is usually the responsibility of the submitting activity to monitor the progress of the

proposal through review, approval, and implementation. The submitting activity should take the initiative for providing any assistance it can to ensure that delays in acting on the proposal are minimized.

C6.3. GAINING VEP ACCEPTANCE

There are many ways to improve the probability and reduce the time required for acceptance and implementation of proposals. The most successful within the DoD environment are:

C6.3.1. Consider the Reviewer's Needs. Use terminology appropriate to the training and experience of the reviewer. Each proposal is usually directed toward two audiences. First is the technical authority who requires sufficient technical detail to demonstrate the engineering feasibility of the proposed change. Second are those reviewers for whom the technical details can be summarized while the financial and procurement implications (implementation costs and likely benefits) are emphasized. Long-range effects on policies, procurement, and applications are usually more significant to the manager than to the engineer.

C6.3.2. Progress Reports "No Surprises." The manager who makes an investment in a VE action expects to receive periodic progress reports with estimates of potential results. Reporting is a normal and reasonable requirement of management. It helps ensure top management awareness, support, and participation in any improvement program. There are very few instances where managers have been motivated to act by a one-time exposure at the "final presentation," no matter how "just" the cause. Therefore, it is advisable to discuss the change with the decision-makers or their advisers prior to submitting it as a formal change. This practice familiarizes key personnel with impending proposals, and enables them to evaluate them more quickly after submittal. Early disclosure may also serve to warn the originators of any objections to the proposal. This "early warning" will give the originators opportunity to incorporate modifications to overcome the objections. Often these preliminary discussions produce additional suggestions that improve the proposal and enable the decision-maker to contribute directly. If management has been kept informed of progress, the presentation may be only a concise summary of final estimates, pro and con discussion, and perhaps formal management approval.

C6.3.3. The "Action" Board Technique

C6.3.3.1. Approval authority for a VE proposal may be vested in one individual; but seldom does an individual possess all the specialized knowledge required

to make an informed decision. The decision is usually reached after weighing the advice of specialists. One method of easing the task of the decision maker is to incorporate into the review procedure a Technical and Management Action Board (TMAB). The TMAB meets to hear, discuss, and review VEPs. The board should consist of those personnel upon whose advice the responsible manager will ultimately base his or her decision. This mechanism ensures timely communication among the responsible organizational components.

C6.3.3.2. In addition to the normal data package presented with each proposal, the TMAB may also request the originators to prepare the documents necessary to revise handbooks, catalogs, contract-change notices, purchase requests, and all of the data necessary for the Configuration Control Boards. The VEP originators meet with the TMAB periodically and collectively discuss each proposal so that any misunderstanding can be identified and promptly resolved. Upon completing the review, the TMAB may then approve the proposal for implementation. If the proposal is disapproved, the TMAB informs the originators of the reason(s) for disapproval. Sometimes a minor change may make the proposal acceptable.

C6.3.3.3. During these meetings, the nuclei of additional VEPs may be generated. The TMAB often includes on its agenda discussions of preliminary proposals (those not yet submitted in final form). The TMAB then offers to the originators of the preliminary proposals guidance concerning road blocks, previous history, and additional areas of possible opportunity. This early rapport between those originating and those reviewing proposals tends to improve the VE yield.

C6.3.3.4. Several DoD contractors report use of similar decision board procedures with their VE task force efforts and training seminars to improve proposal acceptance. The primary advantages of the review board concept are that it generally increases VEP acceptance rates, and decreases VEP processing and implementation time. These same insights are also applicable to contractor generated VECPs. Early warning, no suprises, and appropriate marketing emphasis are equally useful for contractor VECP sumittals. An understanding of the operation of configuration management processes are also vital elements of successful contrators VE efforts.

C6.3.4. Relating Benefits to the Long-Term Organizational Objective

C6.3.4.1. A VE action that represents an advancement toward some approved objective is most likely to receive favorable consideration from management. In the DoD, the potential of a proposal is not a profit but a capability. Therefore the presentation should exploit all of the advantages a proposal may offer toward fulfilling organization objectives and goals. When reviewing a proposal the DoD manager

normally seeks either lower total cost or increased combat capability for the same or lesser dollar investment. The objective may be not only savings but also the attainment of some other mission-related goal.

C6.3.4.2. In industry, reducing costs helps to achieve adequate profits to ensure survival of the business and its attendant job opportunities. Properly presented industry in-house proposals should:

C6.3.4.2.1. Communicate the expected contribution to profit or other benefits.

C6.3.4.2.2. Give more attention to competitive position. The proposal should contain an analysis of the competitive situation and mention any competitive advantage offered by prompt implementation. Industry management is interested in competitors' actions or likely reactions. Management is very likely to accept recommendations that show an opportunity to gain competitive advantage or offset a disadvantage. For example, if an offering price is currently above that of a competitor, the entire projected cost savings might be converted into a price reduction to capture a marketing opportunity with the Department of Defense. This consideration belongs in the VEP whenever possible.

C6.3.5. Support the Decision-Maker. The dollar yield of a VEP is likely to be improved if it is promptly implemented. Prompt implementation in turn, is dependent upon the expeditious approval of the individuals responsible for a decision in each organizational component affected by the proposal. These individuals should be located and the entire VE effort conducted under their sponsorship. The VE group becomes the decision-maker's staff preparing information in such a manner that the risk can be weighed against the potential reward. Like any other well-prepared staff report, each VEP should satisfy any questions likely to be asked and include sufficient documentation to warrant a favorable decision with reasonable risk factors (both technical and economic).

C6.3.6. Minimize Risk. If VE proposals presented to management are to be given serious consideration, they should include adequate evidence of a satisfactory return on the VE investment. Often current contract savings alone will ensure an adequate return. In other cases life-cycle or total-program savings must be considered. Either way evidence of substantial benefits will improve the acceptability of a proposal. The cost and time spent in testing to determine the acceptability of a VE proposal may offset a portion of its savings potential. Committing such an investment with no guarantee of success constitutes a risk that could deter acceptance of a VEP. This risk may be reduced by prudent scheduling of test programs to provide intermediate

assurances indicating the desirability of continuing with the next step. Thus, the test program may be terminated or the proposal modified when the concept first fails to perform at an acceptable level. Major expenditures for implementing proposed VE actions should not be presented as a lump sum aggregate, but rather as a sequence of minimum-risk increments. A manager may be reluctant to risk a total investment against total return, but may be willing to chance the first phase of an investment sequence. Each successive investment increment would be based upon the successful completion of the previous step.

C6.3.7. Combine Testing. Occasionally a significant reduction in implementation investment is possible by concurrent testing of two or more proposals. Also, significant reductions in test cost can often be made by scheduling tests into other test programs scheduled within the desirable time frame. This is particularly true when items to be tested are a part of a larger system also being tested. However, care must be exercised in instances of combined testing to prevent masking the feasibility of one concept by the failure of another.

C6.3.8. Show Collateral Benefits of the Investment. Often VE proposals offer greater benefits than the cost improvements specifically identified. Some of the benefits are collateral in nature and difficult to equate to monetary terms. Nevertheless, collateral benefits should be included in the proposal. The likelihood of acceptance of the VEP is improved when all of its collateral benefits are clearly identified and completely described.

C6.3.9. Acknowledging Contributors. An implemented VE proposal always results from a group effort. All individuals and data sources contributing to a proposal should be clearly identified. Identification of contributors provides the reviewers with a directory of sources from which additional information may be obtained. In addition, individuals, departments, and organizations should be commended when it is deserved. This recognition promotes cooperation and participation essential to the success of subsequent VE efforts.

C6.4. IMPLEMENTATION AND FOLLOW-UP PHASE

C6.4.1. DoD experience with military equipment indicates that implementation and test costs may run $6 to $10 for each dollar of VE study cost. The need to invest to save must be emphasized when submitting change proposals. Some degree of investment is required if a VE opportunity is to become a reality. Funds for implementation have to be provided. Within the Department of Defense, the organizational component responsible for implementing accepted proposals, must

request funds and budget and schedule the effort necessary. In some instances implementation can be accomplished in a matter of days. In situations where the need is not immediate or when extensive laboratory or field testing is required, implementation may take up to two years.

C6.4.2. Regardless of the length of time needed, the key to successful implementation lies in scheduling the necessary actions into the workload. Management should review progress periodically to insure that any roadblocks that arise are overcome promptly. If the responsible personnel also contributed to the proposal they are likely to sustain effectively the implementation program. Once implemented, proposals and their associated savings shall be included in the DoD VE reporting system and entered into the VE databases.

C6.4.3. Within the Department of Defense, VE action officers are required to enter information on implemented in-house VEPs and contractor submitted VECPs into the DoD Value Engineering Data Information Storage and Retrieval System (VEDISARS). A sample of the VEDISARS data entry form (DD Form 2333, GIDEP Value Engineering (VE) Database Report) is shown in Figure C6.F2. VEDISARS is operated by the Officer in Charge, Government-Industry Data Exchange Program (GIDEP), who is located at the U.S. Navy Fleet Analysis Center, Corona, California. The purpose of VEDISARS is to maintain a database of accepted and implemented VE actions that may be of use to others.

C6.4.4. Approximately 1,000 clients in both Government and industry are served by the GIDEP. Clients receive periodic reports and one-time priority notifications concerning quality and reliability problems as well as information on the other databases maintained by the GIDEP. An on-line database search capabability is also available for the VE (VALU) database as well as the other databases.

C6.4.5. GIDEP is a funded activity. Its clients are served at no cost. All DoD personnel who are listed in the DoD VE Points of Contact have been assigned GIDEP location codes and may access GIDEP by using any type of compatible terminal or personal computer.

C6.5. SUMMARY

C6.5.1. Successful presentation, implementation, and follow-up of VEPs and VECPs requires proper planning, procedures, and communications. Early determination of the key decision-makers and subsequent coordination and communication with these individuals during the VE study can minimize roadblocks. Coordination and cooperation

with all elements concerned can develop proposal support prior to formal submittal. Approval action is best expedited by an informed management. Thus the action originators are obligated to keep the derision-makers advised of progress, a preview of what to expect, and submit complete documentation to answer all questions that are likely to be asked.

C6.5.2. Use of the action board technique establishes a channel of communication and coordination to expedite approval and implementation of proposals. Prior to the start of any VE effort, management should plan to make available the funds necessary to implement the anticipated proposals. Documentation should include factors to justify the investment necessary for implementation. The proposal should provide information relating to benefits in life cycle and collateral savings and long-term organization objectives. The originator should consider the risk factor undertaken by management when preparing a presentation. A list of individuals recognized as contributors to a VE effort serves as a directory of sources of additional information.

Figure C6.F1. Facsimile DoD In-House Value Engineering Proposal (VEP)

1. Proposal Title: _____ Dept./Agency:_____

Items/Component/Subsystem:_____ Originating Activity_____

System/Project Title: _____ Location: _____

PROJECT INITIATOR/TEAM PERSONNEL

Name	Activity Office Symbol	Tel. Ext.

II. CONCEPT BEFORE VE APPLIED

Describe original status and function using sketch/photo, parameters/ procedures and cost basis:

PROPOSED CONCEPT AFTER VE APPLIED

Describe proposed change and that basis for lower overall cost, including any other added benefits:

(Attach additional supporting information and description when helpful to explain any of Parts II/III.)

(1) Gross est. savings to DoD Current FY: _____

(2) Less total est. offsetting costs:_____

(3) Est. net savings Current FY: 2nd FY:_____ 3rd FY:_____

III. IMPLEMENTATION OF VEP

Approved

By: _____ Date: _____

Activity: _____

Disapproved

By: _____ Date:_____

Activity: _____

Reason: _____

Contract/Work Order Affected: _____

Funding Citation: _____

(If more space needed, use other side.)

Figure C6.F2. GIDEP Value Engineering (VE) Database Report

GIDEP VALUE ENGINEERING (VE) DATA BASE REPORT
VE DATA INFORMATION STORAGE AND RETRIEVAL SYSTEM (VEDISARS)
(NOTE: Items in brackets [ ] are searchable; others are not.)

REPORT CONTROL SYMBOL: DD-DR&E(AR)1655

[1.] TITLE OF VE ACTION

[2.] INTERNAL CONTROL NO.

[3.] DATE OF SUBMISSION *(YYMM)*

[4.] TYPE OF ACTION (X one): a. VECP ☐ b. VEP ☐

[5.] DOD COMPONENT

[6.] REPORTING ACTIVITY/COMMAND

[7.] CATEGORY *(X one)*

a. AIRCRAFT ☐	d. SHIP/BOAT ☐	g. SUBMARINE ☐	j. SPACE CRAFT ☐
b. WHEEL VEHICLE ☐	e. TRACK VEHICLE ☐	h. SUPPORT ☐	k. COMMUNICATIONS ☐
c. SOFTWARE ☐	f. CONSTRUCTION ☐	i. MISSILES ☐	l. AMMUNITION ☐

[8.] FUNCTION

[9.] ITEM NOMENCLATURE

[10.] MAJOR SYSTEM *(X one)*: YES ☐ NO ☐

11. SYSTEM IDENTIFICATION

[12.] PART NUMBER

[13.] NATIONAL STOCK NUMBER *(NSN)*

14. SAVINGS / BENEFITS BY FISCAL YEAR

a. FY $ K	b. FY $ K
c. FY $ K	d. FY $ K

15. APPROPRIATION *(Title)*	16. PROGRAM ELEMENT	17. COST TO DEVELOP AND IMPLEMENT $ K	18. FUNDING APPROPRIATION

19. POINT OF CONTACT

a. NAME *(Last, First, Middle Initial)*

b. TITLE

c. OFFICIAL ADDRESS *(Command, Division, Street, City, State, Zip Code)*

d. PHONE NUMBER
(1) AUTOVON
(2) COMMERCIAL
(3) FTS

20. CONTRACT NUMBER

21. CONTRACT MODIFICATION NUMBER AND DATE

22. CONTRACTOR NAME

23. CONTRACTOR IDENTIFICATION NUMBER

24. THIS ACTION RESULT OF DATA BASE SEARCH? *(X one)*	25. THIS ACTION RESULT OF VE COURSE / WORKSHOP *(X one)*	26. THIS ACTION RESULT OF VECP FROM SUBCONTRACTOR? *(X one)*
YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐

[27.] KEY SEARCH WORDS

28. DESCRIPTION OF VE ACTION *(Continue on separate sheet if necessary.)*

29. SUBMITTING OFFICIAL

a. TYPED NAME *(Last, First, Middle Initial)*	b. SIGNATURE	c. DATE SIGNED *(YYMMDD)*

DD Form 2333, DEC 84 *Previous edition is obsolete.*

Figure C6.F3. Instructions for Completion of DD Form 2333

INSTRUCTIONS FOR COMPLETION OF DD FORM 2333

Use DD Form 2333 to report approved and implemented VE actions in the VE Data Information Search and Retrieval System (VEDISARS).

Forward typed original to: GIDEP Operations Center, Attn: VE
Corona, CA 91720-5000

[1.] TITLE OF VE ACTION. Enter the title of the VE action. *(60 characters or less)*

[2.] INTERNAL CONTROL NUMBER. Enter the Reporting Command/Activity Control Number used to track the action internally. Example: NAVELEX VECP 8500004LS *(20 characters or less)*

[3.] DATE OF SUBMISSION. Enter current date in 4 digit format of year, month. Example: July 27, 1984 would be 8407.

[4.] TYPE OF ACTION. Mark type of action.

[5.] DOD COMPONENT. Enter the name of the DoD component preparing the report; i.e., Army, DLA, etc. *(10 characters or less)*

[6.] REPORTING ACTIVITY / COMMAND. Enter name of the activity reporting the action, OR if known, the VE activity address code assigned by GIDEP Operations Center. Example: AMC-MICOM OR XX12.

[7.] CATEGORY. Mark the applicable category.

[8.] FUNCTION. Enter the major function(s) expressed in a verb-noun format. Example: transmit torque. *(30 characters or less)*

[9.] ITEM NOMENCLATURE. Enter the noun nomenclature of the item actually being value engineered. *(40 characters or less)*

[10.] MAJOR SYSTEM. Mark the applicable box based on the definitions in DODI 5000.2.

11. SYSTEM IDENTIFICATION. Enter name of highest assembly / system the value engineered item is a part of; i.e., M1 Tank, F15 Aircraft, etc.

[12.] PART NUMBER. Enter the part number assigned in the technical data package for the value engineered item. *(20 characters maximum)*

[13.] NATIONAL STOCK NUMBER (NSN). Enter the NSN of the value engineered item OR if not assigned, enter Federal Supply Class (FSC).

14. SAVINGS / BENEFITS BY FISCAL YEAR. Enter the net savings to DoD by fiscal year and dollars in thousands.

15. APPROPRIATION. Enter the name of the appropriation benefitting from the VE action; i.e., RDTE, Procurement, etc.

16. PROGRAM ELEMENT. Enter the specific program element under the appropriation directly benefitting from the VE action.

17. COST TO DEVELOP AND IMPLEMENT. Enter the total cost (in thousands of dollars) to develop and implement the VE action.

18. FUNDING APPROPRIATION. Enter the name of the appropriation which funded the development and implementation of the VE action.

19. POINT OF CONTACT. Enter the specified data.

20. CONTRACT NUMBER. Enter the number of the contract the VECP was submitted under, if this is a VECP action. See Item 4.

21. CONTRACT MODIFICATION. Enter the number and date of the contract modification that incorporated the VECP.

22. CONTRACTOR NAME. Enter the name of the contractor/company that submitted the VECP.

23. CONTRACTOR IDENTIFICATION NUMBER Enter the 9 digit alphanumeric DUNS code number for the contractor. *(Reference DoD FAR Supplement, Section 4.671- 5(b)(4)(i))*

24. DATA BASE SEARCH. Mark appropriate box, specifying whether this action was result of VEDISARS / GIDEP search.

25. VE COURSE / WORKSHOP. Mark appropriate box.

26. VECP FROM SUBCONTRACTOR. Mark appropriate box.

[27.] KEY SEARCH WORDS. Enter additional key search words not stated elsewhere in searchable portion of form.

28. DESCRIPTION OF VE ACTION. Describe VE Action.

29. SUBMITTING OFFICIAL. Typed name and signature of the local VE or GIDEP representative and date form signed.

NOTE: Item numbers in brackets [ ] are searchable; others are not.

DD Form 2333 Reverse, DEC 84

C7. CHAPTER 7

TRAINING

C7.1. INTRODUCTION

C7.1.1. Continuing emphasis on VE training is a prerequisite for realizing the full potential of VE. It is necessary to train personnel to use VE techniques and to establish and maintain a favorable climate for VE within the organization. Although VE courses are a part of the available curricula at several schools and universities, at present VE is not offered as a major subject for academic study, as is, for example, electrical, mechanical, industrial, or civil engineering. Consequently, most organizations must undertake a planned program of VE training in order to acquire sufficient skilled manpower to properly operate a VE program. VE training programs also serve to demonstrate a management interest in the development of additional skills by its employees. Therefore, a good VE training program serves the interest of both management and the employees.

C7.1.2. There are several categories of VE training. They are:

C7.1.2.1. Intensive - designed to teach the VE methodology to those whose responsibilities require it (engineers, designers, etc.).

C7.1.2.2. Limited - a broad indoctrination or orientation to acquaint staff and management personnel with principles and objectives of VE.

C7.1.2.3. Contractual - to acquaint Government and contractor personnel with the provisions of the VE contract clauses in the FAR.

C7.1.3. These training categories are not mutually exclusive, nor will every organization need to employ all of them at one time. Decisions as to what type are appropriate and who is to be trained depend upon the size and scope of the organization.

C7.2. IMPLEMENTING A VE TRAINING PROGRAM

C7.2.1. Training Responsibilities. A VE training program requires participation by many organizational elements. Coordination by a central source is desirable to avoid conflict, duplication, and dilution of the primary effort. A VE training coordinator is generally designated to act as the focal point for the entire effort. Each agency or department may designate one person to coordinate its participation in the training

program. Most large DoD and industrial organizations have training staffs, usually as a part of personnel or industrial relations departments. While the primary responsibility for VE training must rest with the VE staff, training personnel play a key role. The latter assist VE personnel by coordinating VE training efforts with the organization's overall training program, training instructors in teaching techniques, and many other types of assistance that only professional educators can provide.

C7.2.2. Training Plan. A training plan is normally prepared as a portion of the overall VE program plan. It usually includes:

C7.2.2.1. An annual training schedule for the organization and for each subordinate component.

C7.2.2.2. A procedure to assess training effectiveness.

C7.2.2.3. A method for developing an in-house training capability (if none exists and the size of the organization warrants it).

C7.2.3. Training Capability Development

C7.2.3.1. The establishment of in-house training capability reflects the needs of the organization. Therefore, the person responsible for this task should be familiar with VE and with the overall needs of the organization. Where no VE program exists, an in-house training capability may be achieved by obtaining initial VE training outside the organization. Courses such as "Principles and Applications of Value Engineering" (PAVE) and "Contractual Aspects of Value Engineering" (CAVE) are available to qualified DoD personnel. These courses are offered periodically by the Army Management Engineering Training Agency (AMETA), at Rock Island Arsenal, Illinois; the Air Force Institute of Technology (AFIT), at Wright-Patterson AFB, Ohio; and at various locations throughout the country. Often, DoD contractor personnel are permitted to attend these course offerings if space is available.

C7.2.3.2. Other sources of VE training available to Government and contractor personnel are:

C7.2.3.2.1. Consulting organizations with VE training capability.

C7.2.3.2.2. Professional societies (Society of American Value Engineers, Institute of Industrial Engineers, National Contract Management Association, etc.).

C7.2.3.2.3. Colleges and universities (UCLA, Northeastern University, Boston University, University of Wisconsin, etc.).

C7.2.3.2.4. Large defense contractors.

C7.2.3.3. Upon completion of this outside training, a VE training plan can be formulated that satisfies the specific needs of the organization. The next step is to schedule the first in-house workshop utilizing the services of one or more of the sources listed above. For subsequent workshops, large organizations gradually shift to in-house personnel, utimately developing a complete in-house VE training capability.

C7.3. SELECTING VE SPECIALISTS

The typical specialist has a degree in a related discipline or the equivalent in years of experience. For those who are to be trained as full-time VE specialist, it is reasonable to require related academic training in order to enter the field and be able to develop at a reasonable pace. To be successful, a value engineer must exhibit professional competence and be able to present ideas with tact and diplomacy. An effective VE program depends on the skills and persuasiveness of the value engineer to establish close working relationships with all personnel concerned with value. Thus, communications skills should be considered when selecting those who are to be trained as full-time VE specialist.

C7.4. INTENSIVE TRAINING

C7.4.1. Workshop Seminar

C7.4.1.1. Workshop seminars are the main source of formal VE training for operating personnel. Because workshop seminars tend to identify individuals with special aptitude for VE, they also can be considered as one of the first steps in developing qualified full-time value specialists. The seminars provide an opportunity for individuals to display technical and creative abilities and to be observed for evidence of desired communication skills. In addition, workshop seminars give the potential value specialist an opportunity to sample value work before being committed to it. Thus the workshop seminar may be used as a selective filter before proceeding with on-the-job training. In industry, workshop seminars have been successfully conducted by universities, consultants, specialized educational organizations, and by corporations with a VE staff qualified to teach.

C7.4.1.2. The broad objectives of workshop training are to:

C7.4.1.2.1. Educate personnel in VE methodology.

C7.4.1.2.2. Demonstrate to participating personnel that the methodology is effective.

C7.4.1.2.3. Improve communication between all groups concerned with item value.

C7.4.1.2.4. Identify personnel who have a special aptitude for VE.

C7.4.1.2.5. Develop preliminary data for actual VE proposals.

C7.4.1.2.6. Offset part or all of the workshop expenses through savings achieved.

C7.4.1.3. This training gives the individual a thorough understanding of VE and presents a package of specific VE techniques. The basic philosophy underlying most VE training courses is "learn-by-doing". Even the most dedicated skeptic can be convinced of the efficacy of the principles of VE, if the trainee's efforts are rewarded by actual savings. Most organizations usually offer VE training during the normal working hours. Some also offer VE training programs during the employees' off-duty hours. Although the workshop arrangement and curriculum may vary, the following attributes are considered fundamental:

C7.4.1.3.1. Priority of Attendance. Conflict between the pressures of regular work assignments and workshop attendance must be resolved prior to student selection. Regular attendance at the workshop should be required.

C7.4.1.3.2. Duration and Session Schedule. A range of 40 to 80 hours is common. The time is usually divided about fifty-fifty between lecture and project work. Half-day and full-day sessions generally work well; less than half-day sessions have often been found inadequate. The total calendar time between the first session and the last session usually ranges from 2 to 4 weeks. Less than 2 weeks may not provide sufficient turn-around time for the participants to obtain vendor quotations or other cost data for their projects.

C7.4.1.3.3. Participants. Workshop size will vary according to the organizational needs and the availability of experienced personnel to serve as team-project leaders. Experience indicates the optimum group to be about thirty persons. However, satisfactory results have been obtained with larger groups. A larger group requires more careful planning of project work and vendor coordination. Participants at each workshop are drawn from the various line and staff groups such as: engineering (design, project, specification, test), purchasing, manufacturing, reliability,

finance, quality assurance, etc. One or more persons from the following are normally scheduled to attend an early workshop: contracts, sales or marketing, industrial relations, and any other element of the organization whose decisions affect value. These individuals may then serve as the VE training contact within their respective areas and could act as team leaders in subsequent workshops. Significant communication improvements are often achieved between Government agencies and contractors through joint workshop participation.

C7.4.1.3.4. Team Organization and Responsibility. Participants are assigned to teams of three to five people for the project portion. A team of four or five permits more complete coverage of advanced VE methodology such as the development of value standards or a cost target plan for the project. Each team is held responsible for the preparation of a report that describes its application of the lecture theory to their work project. Upon completion of the workshop, these reports normally are submitted to the management of the line organization for possible implementation. Many workshops devote their last few hours to oral presentations to management by team members who present the conclusions and recommendations resulting from their project.

C7.4.1.3.5. Workshop Projects

C7.4.1.3.5.1. Projects are an essential element of the workshop seminar. The participants, working in teams, apply the VE methodology to something of questionable value. Although the basic purpose of seminar project work is to serve as a training exercise, it should offer an opportunity to realize actual savings. An item or product that possesses the following characteristics is most likely to yield significant savings:

C7.4.1.3.5.1.1. It is prejudged as susceptible to cost improvement.

C7.4.1.3.5.1.2. It consists of five to fifty elements.

C7.4.1.3.5.1.3. Item sample and/or mockup is available.

C7.4.1.3.5.1.4. Complete drawings, specifications, and cost data are available.

C7.4.1.3.5.1.5. Total program cost is large enough to achieve a significant saving.

C7.4.1.3.5.1.6. A responsible designer or equivalent agrees to its use as a project.

C7.4.1.3.5.1.7. It is designated as "Unclassified" for military security purposes.

C7.4.1.3.5.2. Projects are usually selected at least 2 to 4 weeks in advance of the workshop. One project per team and a few spares are usually prepared. A distribution of projects representative of the various installations or company activities is desirable. It is not necessary for the participants to have specialized knowledge concerning their projects. A sample data package prepared for a project is included in Figure C7.F1. At the start the team is provided with general guidance including the quantity to be used in calculating savings, learning curve factors, and a policy for computing the cost of implementing changes.

C7.4.1.3.6. Workshop Leadership. Three types of leadership personnel are used in most VE workshop seminars. First, are lecturers who provide the theory and background of the VE methodology and creative problem solving. They must combine an understanding of their topic with an ability to communicate well. Second, guest speakers are used to bring expert knowledge of other pertinent disciplines such as purchasing, quality control, cost accounting, maintenance, contract administration, cost estimating, etc. Third are the project leaders, usually personnel with VE experience, who provide guidance and enthusiastic leadership for the teams during the project work portion of the seminar.

C7.4.1.3.7. Vendors. Vendors are included in workshops to provide information concerning ideas in production, materials, or processes relative to the projects. Their participation should be planned and scheduled as soon as the projects are selected for maximum use to the students.

C7.4.1.3.8. Curriculum. The lecture schedule, prepared in advance, generally includes a curriculum covering all aspects of the VE methodology as discussed in Chapter 6 and 7 as well as other pertinent topics such as: internal cost procedures; contractual aspects of VE; relationship of VE to reliability, quality control, and procurement services; etc.

C7.4.2. On-the-Job Training. On-the-job training is the practical school in which VE trainees learn approved methods of work. They apply the methodology under the tutelage of qualified value specialists and are given the opportunity to learn how to apply basic skills to specific and productive work assignments. In this way, the trainee can be productive while in a training status.

C7.4.3. Rotational Job Assignments. Such assignments are frequently used in conjunction with on-the-job training. It requires the "trainee" value specialist to be assigned to various organizational areas for limited periods of time. These areas may include manufacturing, cost estimating, methods engineering, design engineering, etc. Exposure to other organization elements broadens the individual's perspective and leads to an improved understanding of the complex nature of product value. As a corollary to this, many companies schedule each of their management trainees for an assignment to the VE staff. These assignments tend to increase the level of understanding between the VE staff and middle management.

C7.5. ORIENTATION SESSIONS

C7.5.1. The effective indoctrination of appropriate members of the DoD Component and/or contractor's organization from top management down is vital to the success of the overall VE program. VE is a team effort and widespread understanding of the program leads to improved support. The indoctrination presentation is an important part of a well-balanced training effort. This type of training activity, normally performed by staff value specialists generally consists of orientation sessions of from 1 to 20 hours duration. The sessions introduce the fundamentals, goals, and operation of the VE program. They are intended for audiences other than those expected to attend workshop seminars. This type of presentation is appropriate for personnel whose primary responsibility does not warrant attendance at a full-scale workshop seminar, such as: managers, executives, senior staff personnel, planning personnel, draftsmen, technicians, and newly hired personnel. Although the specific content of indoctrination lectures must be tailored to the needs of the individual activity, they generally include most of the following topics:

C7.5.1.1. Objectives of VE program.

C7.5.1.2. Concepts of value.

C7.5.1.3. Principal VE methods.

C7.5.1.4. Criteria for applying VE.

C7.5.1.5. Organization and operation of the VE program.

C7.5.1.6. Contractual aspects of VE.

C7.5.1.7. Case histories.

C7.5.1.8. Relationship and anticipated contribution of the audience to the VE program.

C7.5.2. Often these orientation sessions are offered as individual modules in DoD training courses offered at several DoD educational institutions. For example, the course to train program managers includes material to explain VE from a program manager's perspective

C7.6. CONTRACTUAL TRAINING

Certain aspects of VE in the defense environment require specialized knowledge of contract management and administration. Training programs to educate personnel in these areas are also necessary. For example, shortly after the implementation of the Armed Services Procurement Regulation (ASPR) VE contract clauses, the need for training those personnel responsible for the administration of these incentives was recognized. A number of courses both within and outside the Government are now offered to explain the concept and operation of the VE portions of the Federal Acquisition Regulation (FAR) and the DoD FAR supplement.

C7.7. INFORMAL TRAINING

Some organizations choose to train personnel for VE through less-formal methods than those previously discussed, or to supplement formal training programs with informal training devices. Some of these informal training approaches are:

C7.7.1. Handbooks and manuals are a means of bringing about a climate of cost awareness throughout the organization. The manuals can be used to demonstrate how to perform VE while the handbooks provide cost data relating to trade-off possibilities, process information, etc.

C7.7.2. Bulletins and newsletters, distributed periodically, containing a section devoted to VE methodology. They act as continuing reminders to employees of the need for better value.

C7.7.3. Technical meetings at which VE films or speakers from other facilities are presented.

C7.7.4. Displays of successful VE case histories may be placed on bulletin boards and other locations throughout the organization. Some organizations have extensive displays in lobbies, visitor and personnel reception rooms, etc.

C7.8. SUMMARY

Training is an important element of a comprehensive VE program that requires proper emphasis if VE is to reach its full potential. A planned training program is needed to provide the necessary skilled personnel for the DoD VE program. Responsibility for the training program is usually assign to a VE training coordinator, who develops and implements a total training plan. The plan may include the development of an in-house training capability if the size of the organization justifies such an effort. A distinction should be made between-full-time training and indoctrination efforts. Workshops may serve as a first step for training value specialists and are the principal means of training other personnel in VE. The training program for value specialists is necessarily more detailed and includes on-the-job training as well as formal instruction. Rotational assignments are often used to improve the value specialist's understanding of the complex nature of product value as well as familiarize management trainees and others with VE.

Figure C7.F1. DATA PACKAGE FOR WORKSHOP PROJECTS

This is not intended as an exhaustive listing but rather as a guide to important considerations.

Drawings, layouts of sketches
- Next assembly
- Assembly
- Detail parts
- Schematics

Cost (actual and/or anticipated)
- Tooling
- Raw material
- Outside purchased parts, tooling
- Inspection
- Fabrication
- Assembly
- Anticipated models

Manufacturing planning and status
- Tooling description
- Handling equipment
- Planning sheets

- Scrap loss
- Lot size
- Packing and shipping

Contact points (names, location, telephone)
- Responsible designers
- Responsible buyers
- Responsible cost analyst
- Specialty consultants
  - Theory
  - Fabrication
  - Quality
  - Field services

Figure C7.F1. DATA PACKAGE FOR WORKSHOP PROJECTS, Continued

Specifications (performance, model, process)
- Customer
- Internal
- Subcontractor

Design criteria and status
- Intended function
- Weight
- Reliability
- Known problem areas
- Design history
- Fabrication history
- Procurement history
- Associated documentation
- Manuals
- Handbooks
- Reports

Contract data
- Incentive
- Quality required
- Anticipated future quantity

Purchasing data
- Responsible buyer
- Participating vendors

Photographs

C8. CHAPTER 8

RELATIONSHIP OF VE TO OTHER PROGRAMS AND DISCIPLINES

C8.1. INTRODUCTION

VE supports the objectives of top management and makes significant contributions to other supporting programs and disciplines. VE brings together the appropriate skills necessary to capture a specific target of opportunity. It uses these skills in a coordinated undertaking to achieve all essential functions at minimum cost. Thus, VE is a means to utilize and manage defense resources more effectively. It complements rather than competes with other activities. The relationship of VE to some of the current DoD programs and disciplines is discussed in the following pages.

C8.2. PROGRAM (PROJECT) MANAGEMENT OFFICES

A major development in management within the Department of Defense is the increased use of the Program (or Project) Management Office (PMO) concept. The PMO structure is intended to centralize and improve the management of major systems to ensure their econommical development, production and operation. It is a means of balancing the desire for maximum usable performance in military material with the need for the largest number of effective force units under a given budgetary allocation. VE contributes to this objective. A sound VE program can help make a product more cost-competitive with other alternatives that are capable of performing the same type of mission. Or, it may serve to make a system economically feasible. In recent years, it has been necessary to terminate some major programs because they were overly complex. The result was excessive cost coupled with inadequate reliability making them unsuitable as weapon systems. VE tends to improve both aspects of this problem because it not only reduces cost, but also results in greater simplicity that usually leads to improved reliability. VE also benefits the force structure. Reducing the unit cost of an item means more units could be acquired for a given budget or that some other approved but unfunded item can be considered for procurement. Thus, lower cost means more units; higher cost means fewer units. By helping to reduce unit costs without sacrificing essential characteristics, VE in a program/project management organization is able to make a significant contribution to our defense posture. See Chapter 4 for an additional discussion on VE in a PMO.

C8.3. COST EFFECTIVENESS

C8.3.1. Cost effectiveness and VE share a common objective. "Both represent a systematic analysis of alternative ways of accomplishing given functions and of the costs associated with each alternative."[6] As practiced, they are applied at entirely different levels. DoD cost-effectiveness studies are employed in the very early planning stage to compare the overall mission effectiveness and associated costs of alternative concepts in broad contexts. Typically, cost-effectiveness studies compare the mission effectiveness and economic impact of:

C8.3.1.1. Alternative designs for fighter aircraft for a particular type of air support mission; or

C8.3.1.2. Missiles versus aircraft for a stategic mission; or

C8.3.1.3. Massive airlifts versus overseas prepositioning of equipment for rapid response.

C8.3.2. There are many opportunities to improve the interaction between cost effectiveness and VE. For example, alternative designs for various aircraft parts might be developed and compared while a specific aircraft design concept was adopted. Thus, a cost-effectiveness study may be complemented by VE efforts to ascertain the value levels of the proposals presented and, if suitable, propose additional alternatives. VE also may be used to achieve or even reduce the cost predicted for the selected alternative.

C8.4. PROGRAM ANALYSIS

C8.4.1. A major development within the Department of Defense is the increased use of program analysis. One author has defined this type of analysis as an "inquiry to assist decision makers in choosing preferred future courses of action by:

C8.4.1.1. Systematically examining and re-examining the relevant objectives and the alternative policies or strategies for achieving them; and

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[6] Wells, Emerson N., "Cost Effectiveness and Value Engineering: A Comparative Analysis," SAVE Proceedings - 1968 National Conference (Chicago: Robert J. Mayer and Co.), page 54.

C8.4.1.2. Comparing quantitatively where possible the economic cost, effectiveness (benefits), and risks of the alternatives. It is more a research strategy than a method or technique and in its present state of development it is more an art than a science."[7] Thus program analysis may be viewed as an approach to, or way of looking at complex problems of choice under conditions of uncertainty.

C8.4.2. This procedure employs high-level operational definitions to describe a system, and traditional cost-analysis techniques to analyze competing systems. During subsequent development of the selected overall systems, design of the subsystems is assigned to various design groups. A coordinating group is assigned the task of assuring that the subsystems will work together. The combined output of these individual groups is a design reflecting the emphasis on achieving functional compatibility and required performance with limited funds and time. Integration of VE into the program analysis effort contributes to the creation of an overall design having a total cost that is consistent with the worth of the system functions.

C8.5. CONFIGURATION MANAGEMENT

Configuration management (CM) of defense systems has the following objectives:

C8.5.1. Provide the configuration identification, control, and status accounting needed for effective development, production, and support;

C8.5.2. Improve the efficiency of instituting changes; and

C8.5.3. Ensure latitude in the design of systems and equipment. These objectives are achieved by processing changes to precisely described baselines through channels in accordance with a systematic procedure. VECPs can often be included in procedures to group all needed changes into blocks and thus minimize the change costs and any adverse effects on supply and maintenance activities.

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[7] Fisher, G.H. The Rand Corporation, Cost Functions and Budgets (Cost Consideration in Systems Analysis), February 1968, page 3. Document AD666-616, Clearinghouse for Federal Scientific and Technical Information, Springfield, VA 22151.

C8.6. STANDARDIZATION

Standardization and VE are not opposing philosophies with the former attempting to freeze the status quo and VE trying to change it. Standardization efforts include procedures to enhance military effectiveness by accommodating innovations in technology and changes in the user's needs. Used where appropriate, standards can reduce total cost. In some cases, unnecessary costs occur because standards are not being used. In other cases, waste may occur because the standards used are obsolete. In either instance, VE may provide a useful input to standardization activities.

C8.7. RELIABILITY, QUALITY ASSURANCE, MAINTAINABILITY

These disciplines are employed to ensure items of defense material that will perform as anticipated when programmed maintenance procedures are followed dollars spent to achieve a specific mission are influenced by equipment readiness. Readiness in turn is affected by the inherent reliability, quality, and maintainability characteristics of a system. These programs and VE are complementary. Proposed VE changes must include consideration of these aspects. Conversely, the solution to a problem in any of the above areas is likely to be beneficially influenced by a VE input. Often, VE leads to less complex solutions that tends to further enhance quality, reliability, and maintainability characteristics.

C8.8. LIFE-CYCLE COSTING

Life-cycle costs include all costs incident to research, development, production, operation, maintenance, and disposal of a system. They are used to compare and evaluate the total costs of competing proposals based on the anticipated life of the product to be acquired. This approach determines the least costly of any alternatives. However, the selected alternatives may only represent the best of several poor candidates. VE may be used to develop additional worthy alternatives to consider before selecting the best choice. Whereas life-cycle costing emphasizes cost visibility, VE seeks optimum value. The two disciplines are complementary because the former is required to achieve the latter.

C8.9. DESIGN TO COST

C8.9.1. The objective of design to cost is to establish:

C8.9.1.1. Cost as a parameter equal in importance with technical requirements and schedules throughout the design, development, production, and operation of weapon systems, subsystems, and components; and

C8.9.1.2. Cost elements as management goals for acquisition managers and contractors to achieve the best balance between cost, acceptable performance, and schedule. DoD Directive 5000.1 requires that design to cost goals be provided to the developer during the development of major weapon systems. VE's functional requirements concept can assist in assigning these goals and the VE methodology can be employed to help achieve the goals.

C8.9.2. Whenever contract terms include design-to-cost incentives it may become necessary to ensure that there is no duplication between VE incentives and design-to-cost incentive fees and awards.

C8.10. LOGISTICS SUPPORT ANALYSIS

The primary objective of logistics support analysis is to ensure the design includes adequate consideration of the effective and economical support of a system or equipment at all levels of maintenance for its programmed life cycle. This approach requires early consideration of maintenance and support needs. VE, when conducted early in the design and development phase, includes logistics considerations in order to assess the total impact on life cycle cost. VE generally results in lower costs for logistics support. The collateral savings feature of VE contract clauses (see Chapter 3) encourages contractors to use their VE capabilities on logistics aspects.

C8.11. QUALITY CIRCLES

C8.11.1. Quality circles are small groups whose members have a common interest in improving a product or their working environment so as to increase productivity. Quality circles often express their overall objectives in wording similar to the following:

C8.11.1.1. To contribute to the improvement of the enterprise and its products.

C8.11.1.2. To acknowledge the importance of the work force.

C8.11.1.3. To fully utilize human capabilities.

C8.11.1.4. To develop a sense of organization and instill the "team spirit."

C8.11.2. Quality circles have achieved remarkable successes in improving the quality and reliability of products, reducing the percentage of defects to an extremely small value, improving productivity, lowering costs, conserving energy and other resources, and reducing errors in business transactions.

C8.11.3. VE and quality circles both strive to achieve a functional product at reduced cost. They both use many of the same tools but differ in methodology and implementation. Both VE and quality circles may be used simultaneously to achieve maximum benefits.

C8.12. SUMMARY

By seeking to achieve greater value, and utilizing the contributions of many organizational elements, VE reinforces the efforts of many programs and disciplines that serve management. The complementary relationship between VE and these programs and disciplines increases the likelihood that overall top management objectives will be achieved.

C9. CHAPTER 9

VE EXAMPLES

C9.1. INTRODUCTION

This Chapter contains examples of successful application of VE demonstrating the broad range of products and circumstances for applying VE effort.

C9.1.1. TF 39 Engine Exhaust Nozzle Replacement

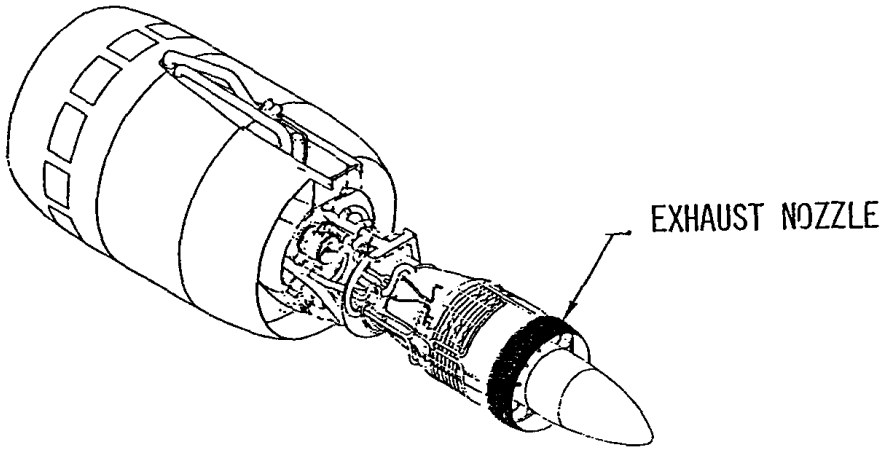
Figure C9.F1. San Antonio ALC Value Engineering (VE) Project

SUBJECT: TF 39 ENGINE EXHAUST NOZZLE REPLACEMENT

BEFORE: $1,141,885.00/YR WAS COST TO OVERHAUL AND REPLACE ENGINE EXHAUST NOZZLES WHICH SEEMED EXCESSIVE. A VE TEAM ANALYZED THE PROBLEM AND INITIATED TESTING ON NOZZLES PREVIOUSLY REMOVED FOR OUT-OF-TOLERANCE DENTS AND BULGES.

AFTER: STUDY AND ENGINE TESTING SHOWED ONLY 15% OF ENGINE THRUST GOES THROUGH THIS NOZZLE AND DAMAGE TOLERANCES COULD BE OPENED FROM .020" TO .50" WITH NO SIGNIFICANT EFFECT. THIS REDUCED FIELD REMOVAL BY 50% AND ALLOWED FIELD REPAIR OF MOST OF THE UNITS; THEREFORE, MOST OF THE EXPENSIVE DEPOT REPAIR WITH ASSOCIATED SHIPPING COSTS WAS ELIMINATED. PREVIOUSLY CONDEMNED NOZZLES COULD BE REWORKED AND RETURNED TO SERVICE.

SAVINGS: $1,038,568.00 FIRST YEAR.



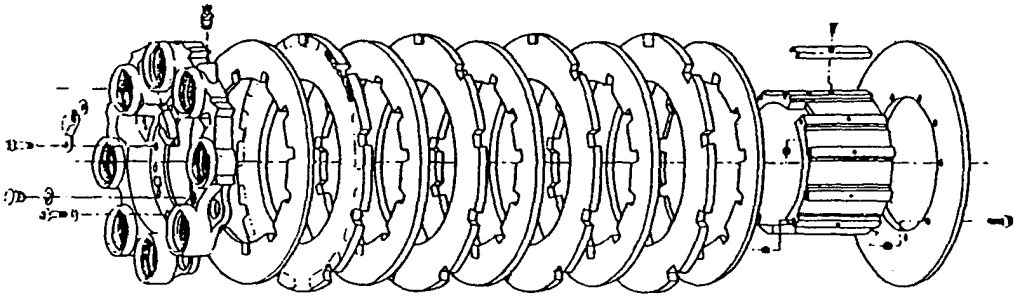
C9.1.2. C-5B Aircraft Landing Gear Brakes. An example of a VE study done on the C-5B aircraft landing gear brakes for the U.S. Air Force is shown below. The VE study centered on the substitution of material, which realized a net savings to the Government of $7,800,000.

Figure C9.F2. MLG Wheel Brakes

BEFORE:

C-5B AIRCRAFT LANDING BRAKES CONSTRUCTED OF BERYLLIUM MATERIAL

1. **MATERIAL SERIOUS HEALTH HAZARD DURING REFURBISHMENT**
2. **HIGH COST MATERIAL**
3. **SPECIAL CLOTHING REQUIRED DURING HANDLING/REFURBISHMENT**
4. **750 LANDINGS**



AFTER:

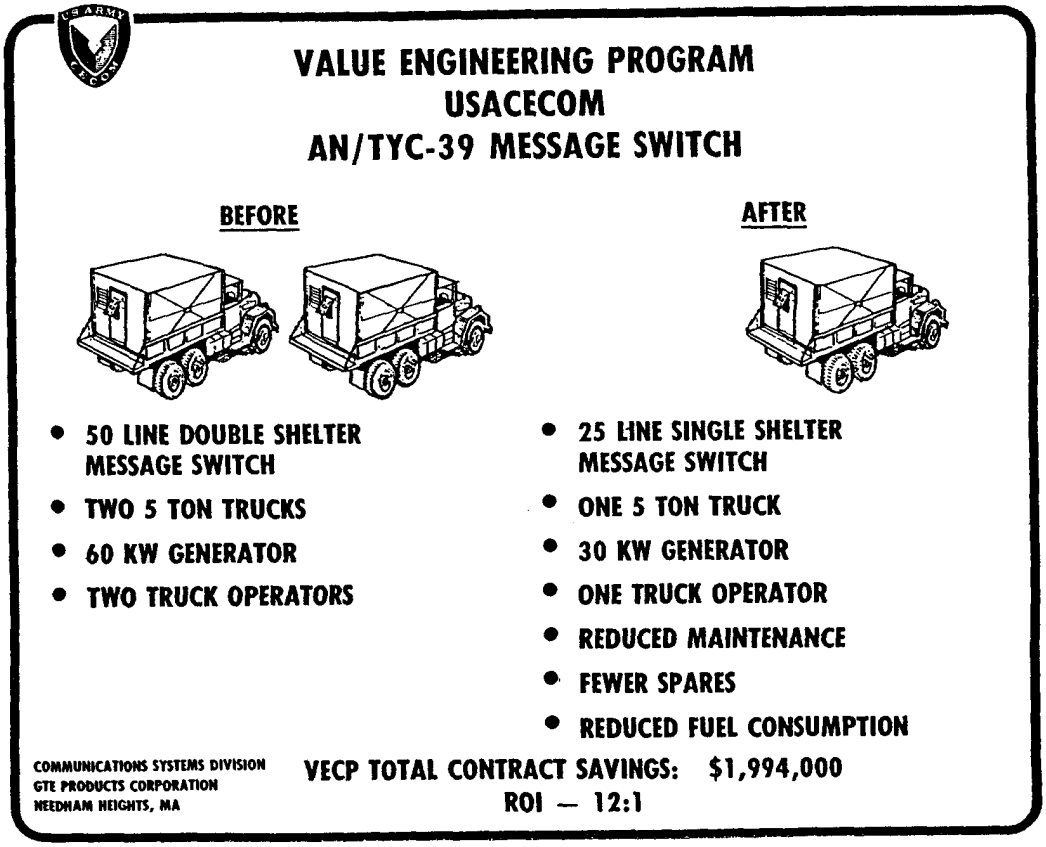
C-5B AIRCRAFT LANDING GEAR BRAKES CONSTRUCTED OF SPECIALLY TREATED HARDENED CARBON MATERIAL

1. **NO HEALTH HAZARD DURING REFURBISHMENT**
2. **LOWER MATERIAL COST**
3. **NO SPECIAL CLOTHING REQUIRED**
4. **SIGNIFICANTLY MORE LANDINGS**

NET OVERALL SAVINGS TO THE GOVERNMENT - $7,800,000

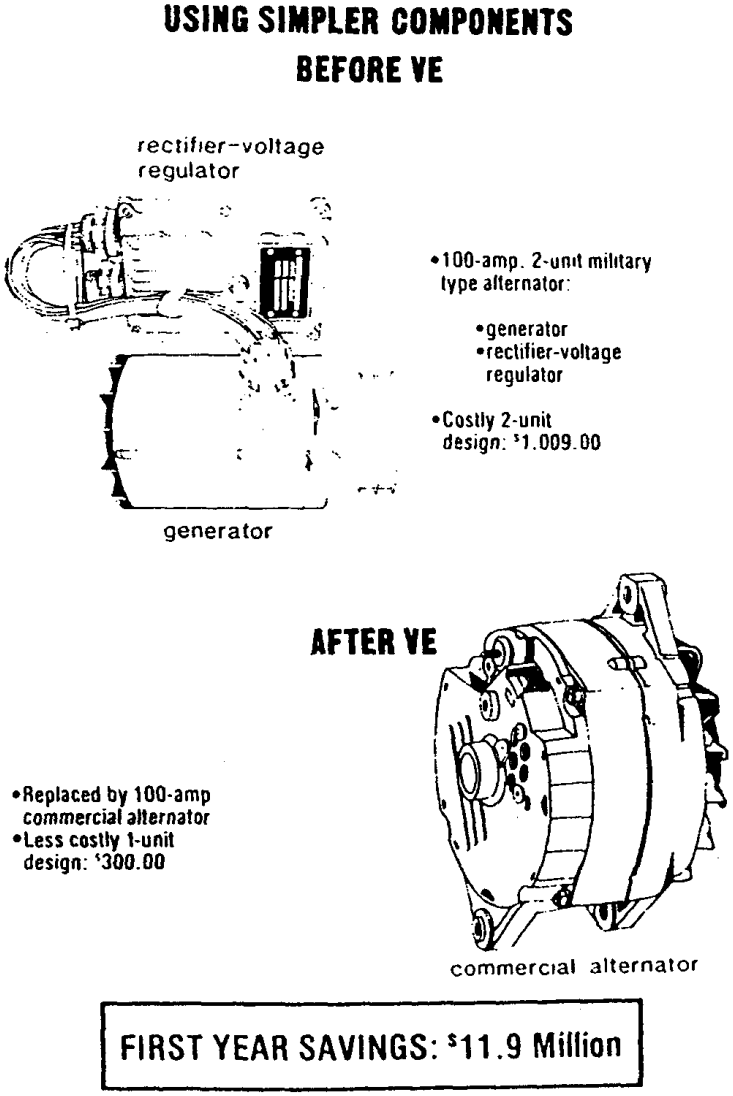
C9.1.3. AN/TYC-39 Automatic Message Switch. The U.S. Army Communications and Electronics Command received and approved a VECP from the contractor to reduce life-cycle costs of the message switch for those applications not requiring a 50-line capability. This was achieved by replacing the existing dual shelter message switch with a single message switch, as shown below. While providing adequate communications capability, the single shelter message switch resulted in savings in equipment acquisition costs, training, maintenance, and operational needs.

Figure C9.F3. USACECOM AN/TYC-39 Message Switch



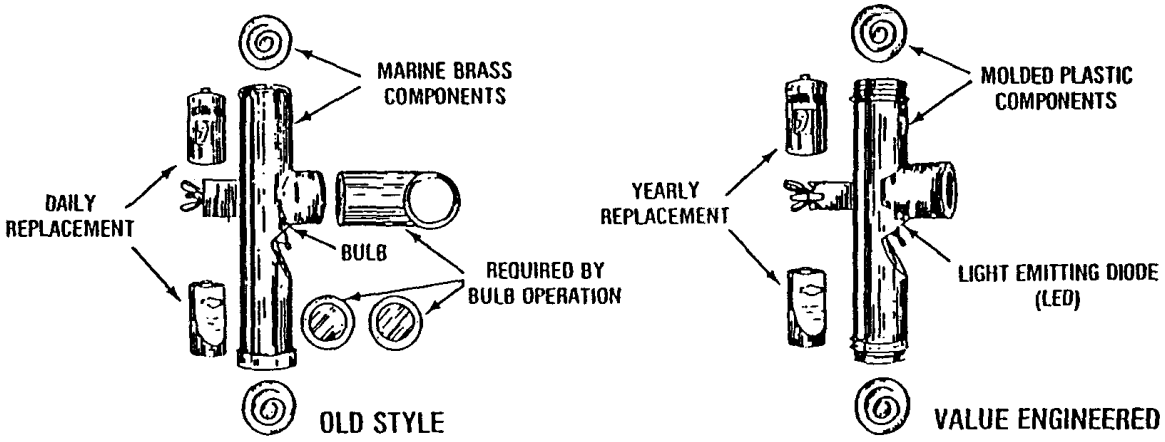
C9.1.4. Use of Commercial Alternator In Lieu of Military Alternator. The U.S. Army Tank-Automotive Command conducted an in-house VE study that researched the possibility of using two commercial 100 AMP alternators in lieu of 180 AMP military-type alternators without sacrificing quality performance. The military-type alternator design features an assembly of two units, a generator and rectifier-voltage regulator. The commercial diode-rectified generator (often called alternator) features a simple one-unit design and is less costly to produce. By replacing the military-type alternator with the commercial unit, improved performance and cost reduction was attained. The first year's net savings was $11,896,163. The implementation cost was $10,000, or a return on investment of 1190 to 1.

Figure C9.F4. U.S. Army Tank-Automative Command



C9.1.5. M14 Aiming Post Light. The U.S. Army Armament Materiel Readiness Command received and approved a VECP on its M14 Aiming Post Light. For the previous design a labor-intensive method of fabrication was seriously limiting the production rate. In addition, the old design resulted in operational and maintenance problems. The heavy draw of the incandescent bulb required daily battery replacement and its non-waterproof design led to frequent failure due to galvanic corrosion. As shown below, the new design permitted higher production rates, extended the battery life to 1,000 hours, and was waterproof. The annual savings achieved through this VECP was $222,497.

Figure C9.F5. IMMCO VECP's 4028-16/17-M14 Aiming Post Light



CHARACTERISTIC	OLD STYLE	VALUE ENGINEERED	IMPROVEMENT
COST	$18.52	$9.25	50%
BATTERY LIFE	8-12 HRS	1000 HRS	9,900%
WEIGHT	19 oz	7 oz	63%
MIN OPERATING TEMP	ABOUT 0°F	BELOW-30°F	SIGNIFICANT
WATERPROOF	NO	YES	SIGNIFICANT
MATERIALS	WARTIME CRITICAL	COMMON	SIGNIFICANT
LIGHT COLOR CHANGE	CHANGE LENSES	FLIP SWITCH	SIGNIFICANT
SHADE	REQUIRED	NOT REQUIRED	SIGNIFICANT
PRODUCTION RATE	LIMITED	VERY HIGH	SIGNIFICANT

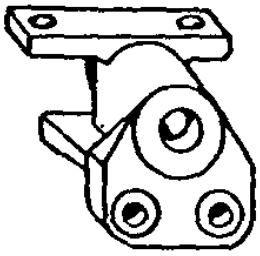
AVG ANNUAL GOVT SAVINGS — $222,500 RETURN ON INVESTMENT —23:1

C9.1.6. M60 Tank Seat Brackets. During the conversion of the M60 Tank from the A1 model to the A3 model tank, it was determined that the seat support brackets for the A1 model series would not work in the A3 model series. New brackets would have to be procured at a cost of $196.53 each. Anniston Army Depot performed a Value Engineering study on the brackets and determined that the A1 model series brackets could be modified for use in the A3 model series at a cost of $12.80 each. This eliminated the new procurement requirement and resulted in a first-year savings of $120,000.

Figure C9.F6. Anniston Army Depot -- First Year Savings: $120,000

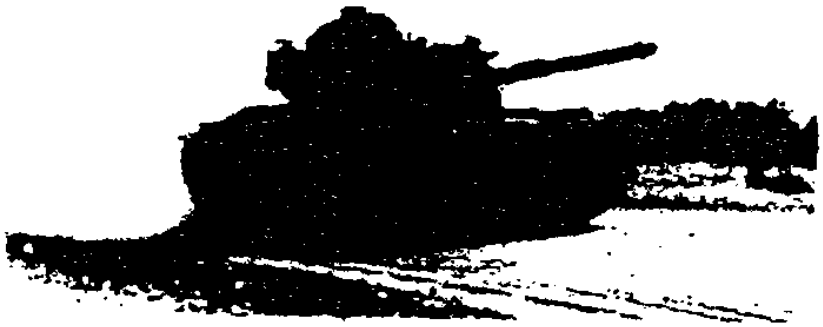
MODIFYING SEAT BRACKETS

BEFORE VE



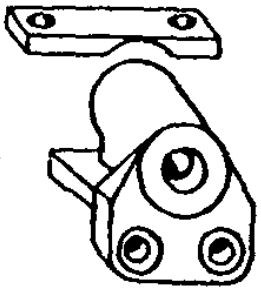
New A3 bracket

- New seat support brackets required for M60 tank conversion from A1 to A3
- New procurement required
- New brackets: $196.53 each

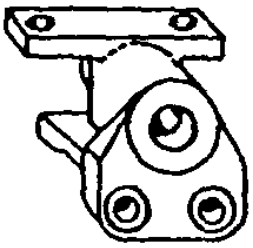


AFTER VE

- Original A1 modified to A3 configuration
- New procurement eliminated
- Modified brackets 12 80 each



Original A1 bracket



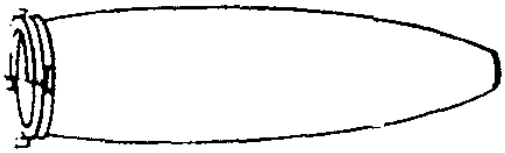
Modified A1 bracket

C9.1.7. MK 82 Bomb Skins. The bomb skin (shell) of the MK 82 Bomb is used during peacetime training. When available supplies were exhausted, a new procurement of the bomb skins was planned. The bomb skins were available from the production contractor at a cost of $430 each. The U.S. Army Armament Materiel Readiness Command conducted a Value Engineering study on the bomb skin and the training requirement. The study determined that old MK 82 bomb skins from items being demilitarized could be refurbished and used for training at a cost of $70.93 each. This resulted in a first-year savings of $3.5 million and a return on investment of 6 to 1.

Figure C9.F7. Refurbishing MK 82 Bomb Skins -- First Year Savings: $3.5M (Return on Investment 6 to 1)

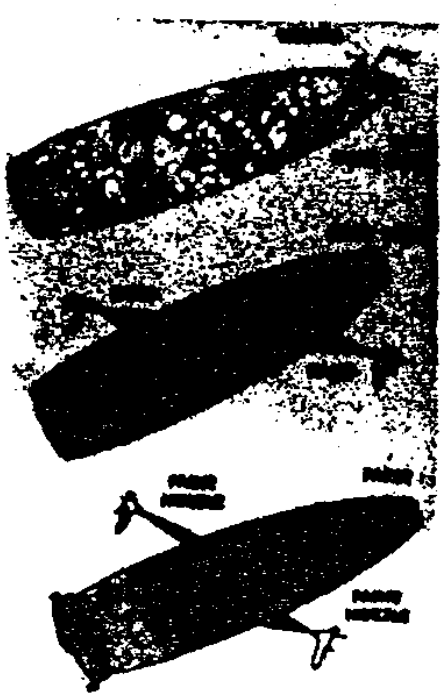
BEFORE VE

NEW BOMB SKIN
FROM PRODUCTION CONTRACTOR



- Bomb skins needed for additional training requirements
- New procurement needed
- New training bomb skins: $430 each

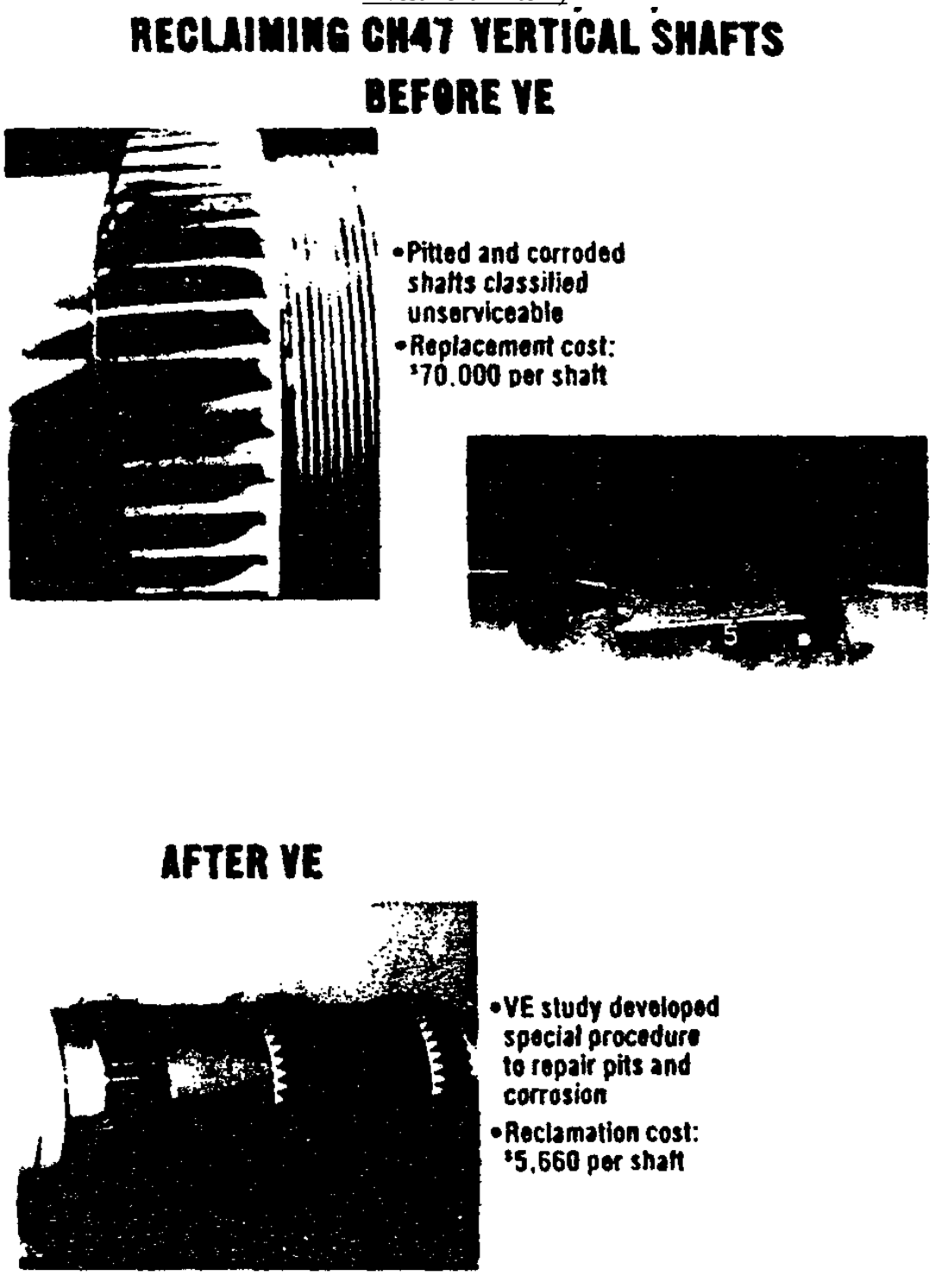
AFTER VE



- In-house refurbishment of available demilitarized bomb skins
- Cost savings per bomb skin $359 07

C9.1.8. Selective Plating Process. In the directorate for maintenance it the New Cumberland Army Depot, there were no rework procedures for certain aircraft components that have nicks, pitting, corrosion, or scratches. These items were scrapped and sold for mixed metal at approximately $0.02 per pound. An in-house VE study was conducted, and the Selection Process was proposed and approved. This process is a completely mobile selective metal depositing deposition system for resizing, restoring and repairing worn or damaged metal parts without the need for costly disassembly, complicated masking, and long periods of down time. The build-up areas will be equal to or have a better metallurgical quality than the existing base metal. There was an annual gross savings of over $5,000,000, with an implementation cost of approximately $34,000 at the New Cumberland Army Depot. This proposal was recommended to be adopted Army-wide. If it is implemented Army-wide the Government should realize an annual savings in excess of $100,000,000.

Figure C9.F8. New Cumberland Army Depot -- First Year Savings: $7.5 Million (Return on Investment 11 to 1)

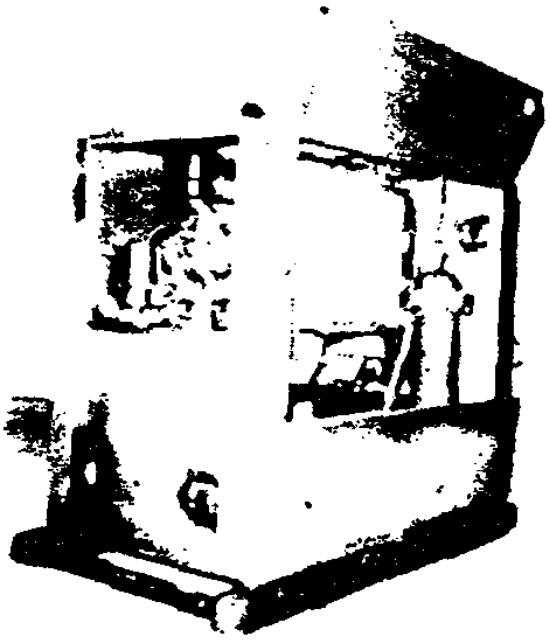


C9.1.9. Compressor. The U.S. Army Mobility Equipment Research and Development Center designed and developed on air compressor for filling air tanks for Army scuba divers. The MIL-SPEC compressor was designed to user requirements. The estimated procurement cost of this compressor was $40,000 each. A Value Engineering study was performed on the design specifications, and the user requirements. The changes to the specifications and user requirements resulting from the study established the "actual" performance requirements. Although commercial compressors could not meet the original specifications and requirements, the "actual" performance requirements could be met by some commercial compressors. Commercial compressors were procured at a cost of $16,000 each. A first-year savings of $879,000 and return on investment of 88 to 1.

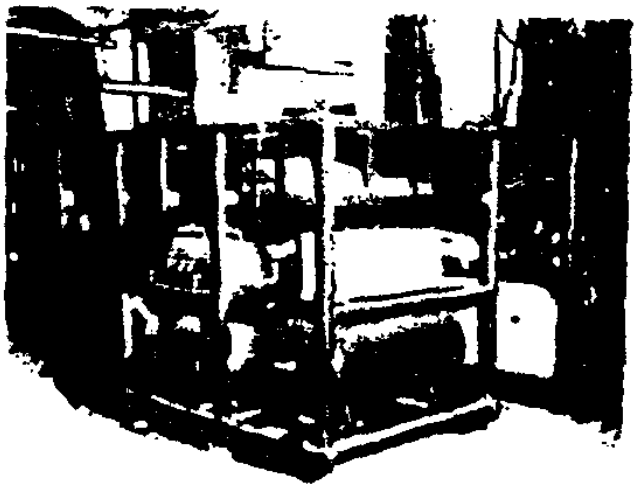
Figure C9.F9. Substitution for MIL-SPEC Compressor -- First Year Savings: $879,000 (Return on Investment 88 to 1)

BEFORE VE

- Rigid air flow rate and pressure specifications
- Suitable commercial compressors not available
- MIL-SPEC compressor Cost: $40.000 each



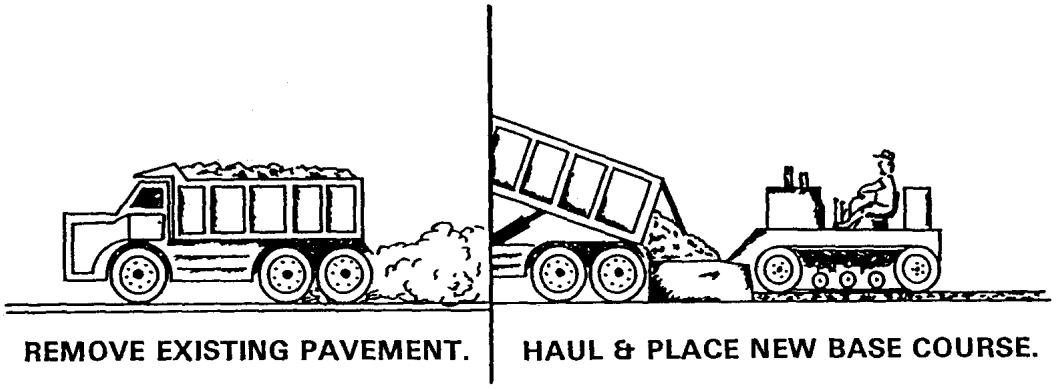
AFTER VE



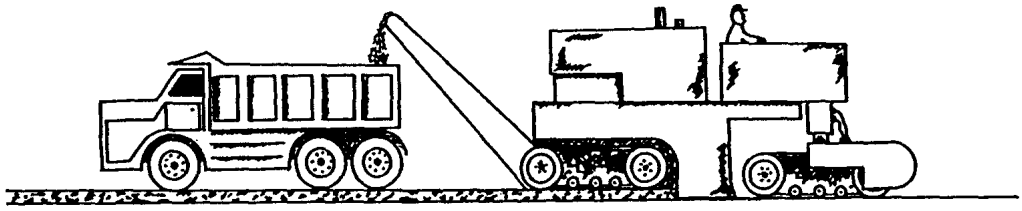
- Military specifications *challenged and changed*
- Some commercial compressors now suitable and safe under new specifications
- Commercial compressor Cost: $16.000 each

C9.1.10. Airfield Taxiway & Apron. Project as designed called for complete removal and replacement of all existing taxiway and apron materials. The contractor's proposal recommended removing the existing ashpalt pavement with a rota mill machine that grinds the material into pebble size granules. Then the recycled material is reused as base course material in lieu of purchasing and hauling in new base material.

Figure C9.F10. Airfield Taxiway & Apron



AS DESIGNED



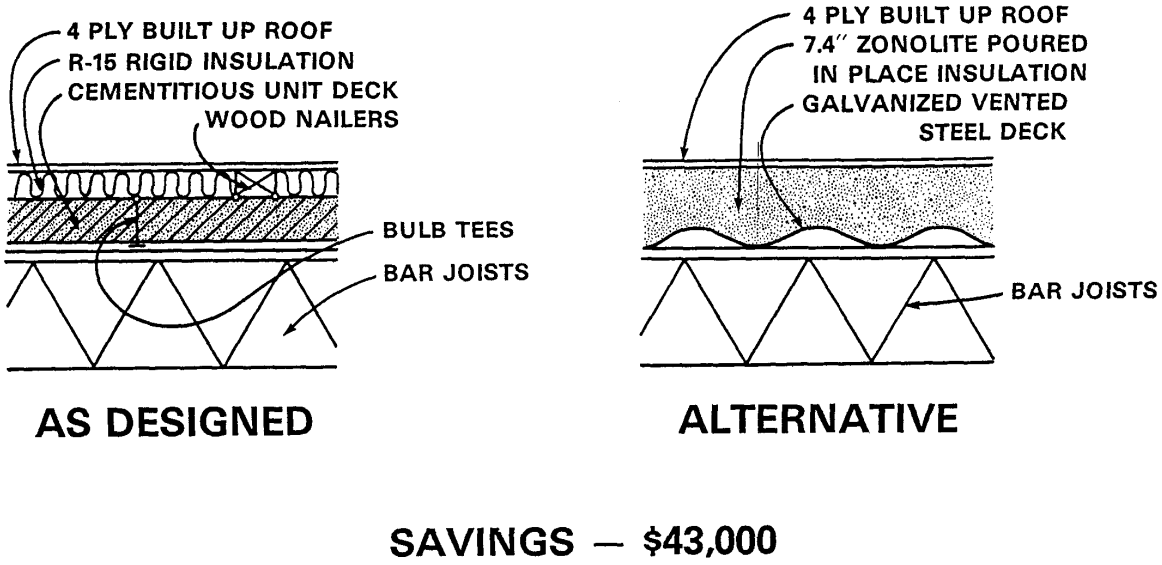
MILL EXISTING PAVEMENT AND REUSE FOR NEW BASE COURSE.

ALTERNATE

SAVINGS — $88,684

C9.1.11. Roof. The original design called for a specialized roof construction of bulb tees, cementations deck, rigid insulation and wood nailers. The contractor's proposal recommended a more conventional and less costly roof construction sequence of steel decking and poured in place zonolite insulation fill. The proposal was evaluated and accepted.

Figure C9.F11. Savings - $43,000

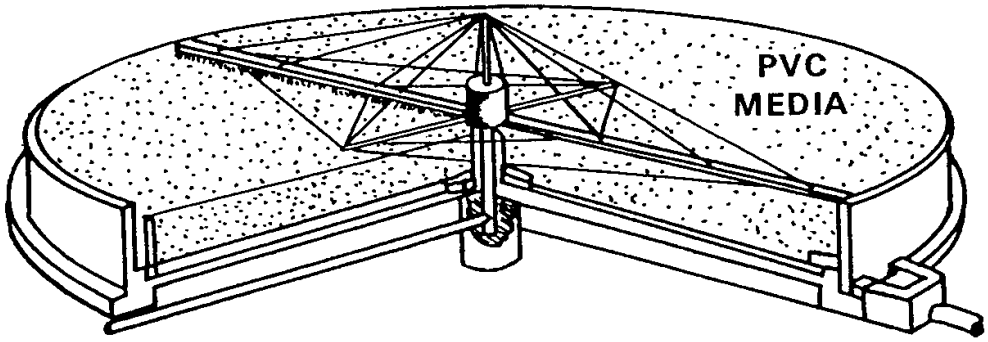


C9.1.12. Sewage Collection & Treatment. The project required reworking the existing trickling filter by removing the existing stone bed (media) and replacing it with a very high cost PVC media. The contractor upon investigation of the existing trickling filter and stone base, recommended removing, cleaning and reinstalling the existing stone media in lieu of installing the very high cost PVC substitute media. The proposal was evaluated and approved.

Figure C9.F12. Sewage Collection & Treatment

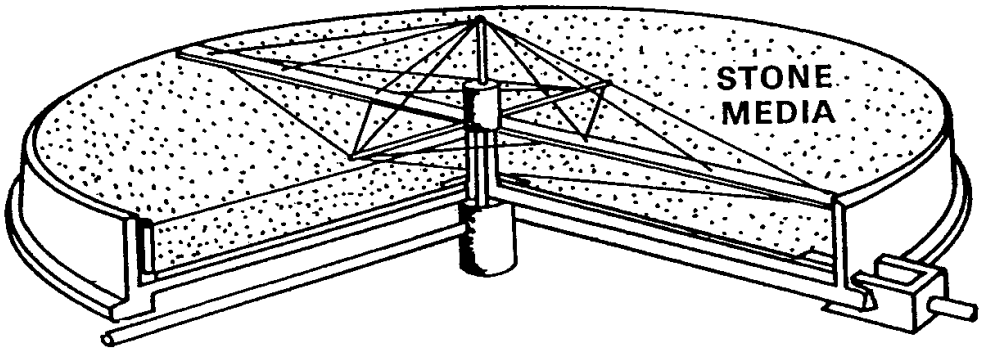
BEFORE:

REMOVE STONE MEDIA & INSTALL PVC MEDIA.



AFTER:

REUSE EXISTING STONE MEDIA.

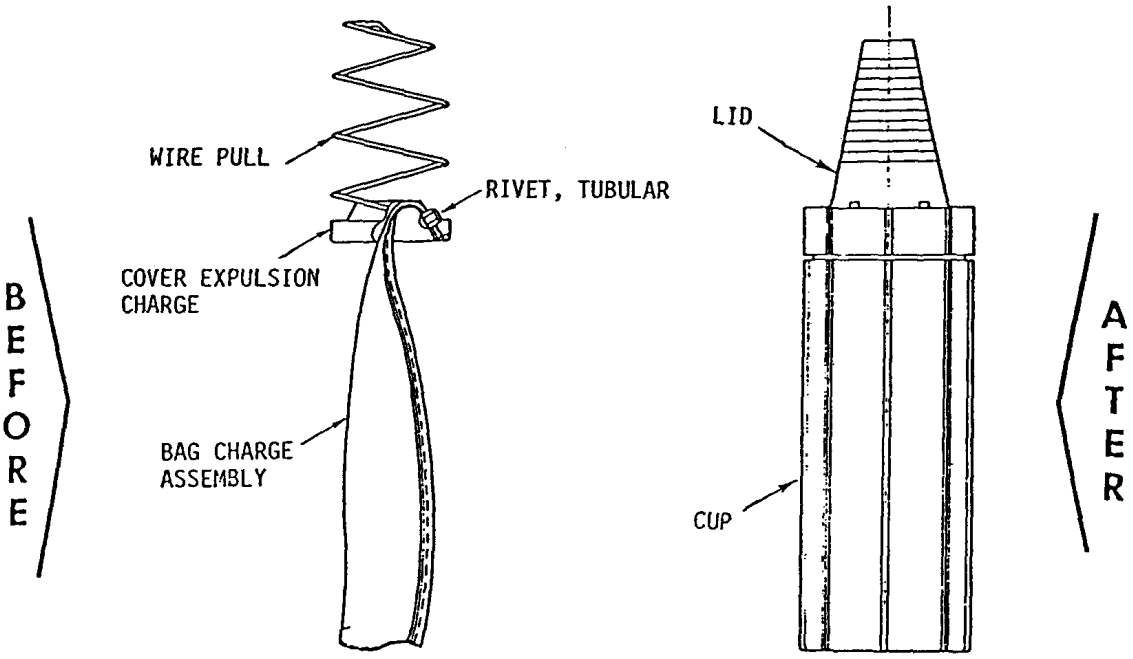


SAVINGS — $338,600

C9.1.13. Expulsion Charge Assembly

Figure C9.F13. Day & Zimmermann, Inc. VEDP KS-4012-154

PLASTIC EXPULSION CHARGE ASSEMBLY
FOR M483A1 - 155MM PROJECTILE



BAG ASSEMBLY **$4.52**

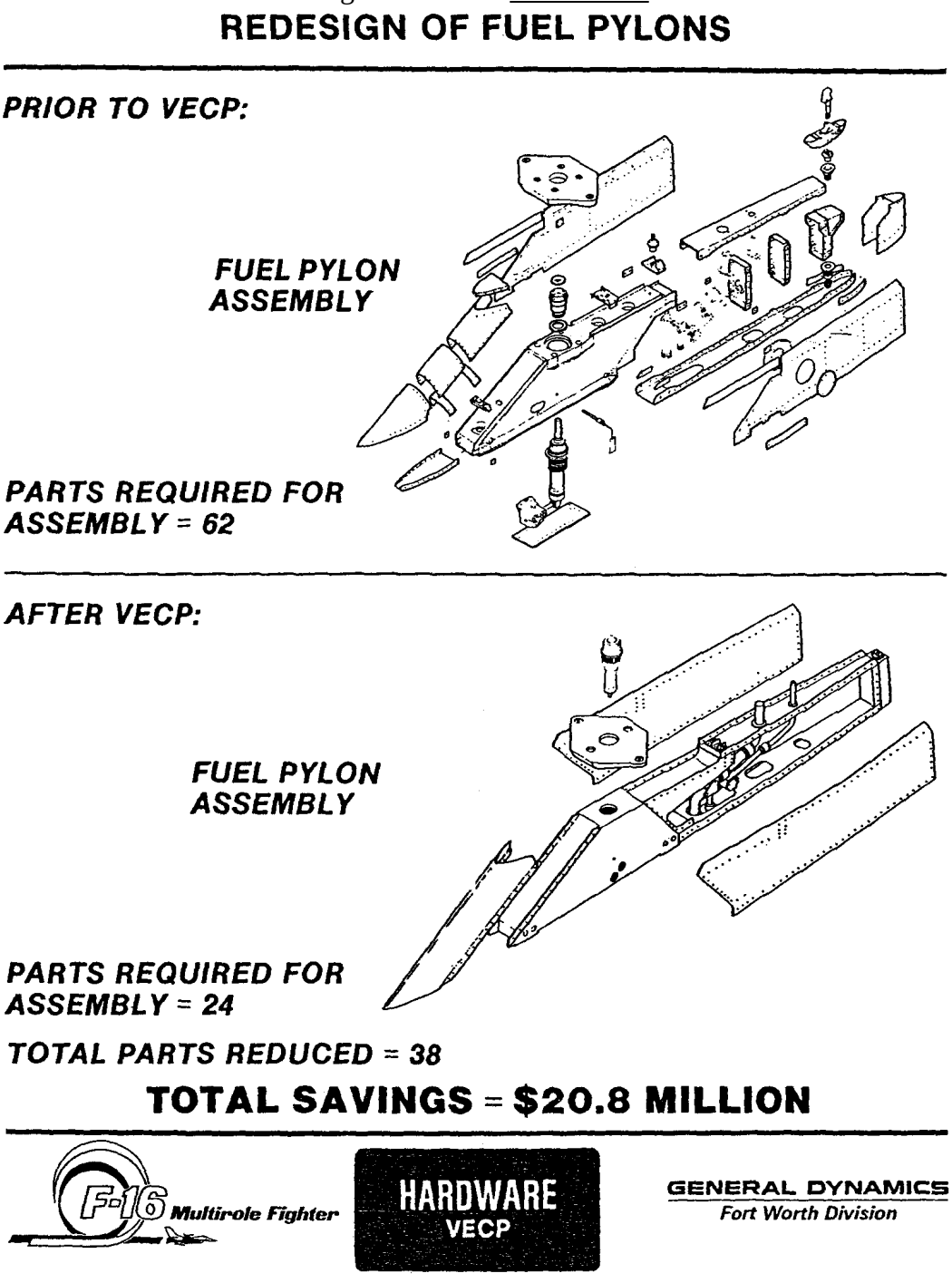
PLASTIC CUP ASSEMBLY **$1.13**

UNIT SAVINGS $3.39

3 YEAR SAVINGS FOR THE US ARMY
$4,680,000

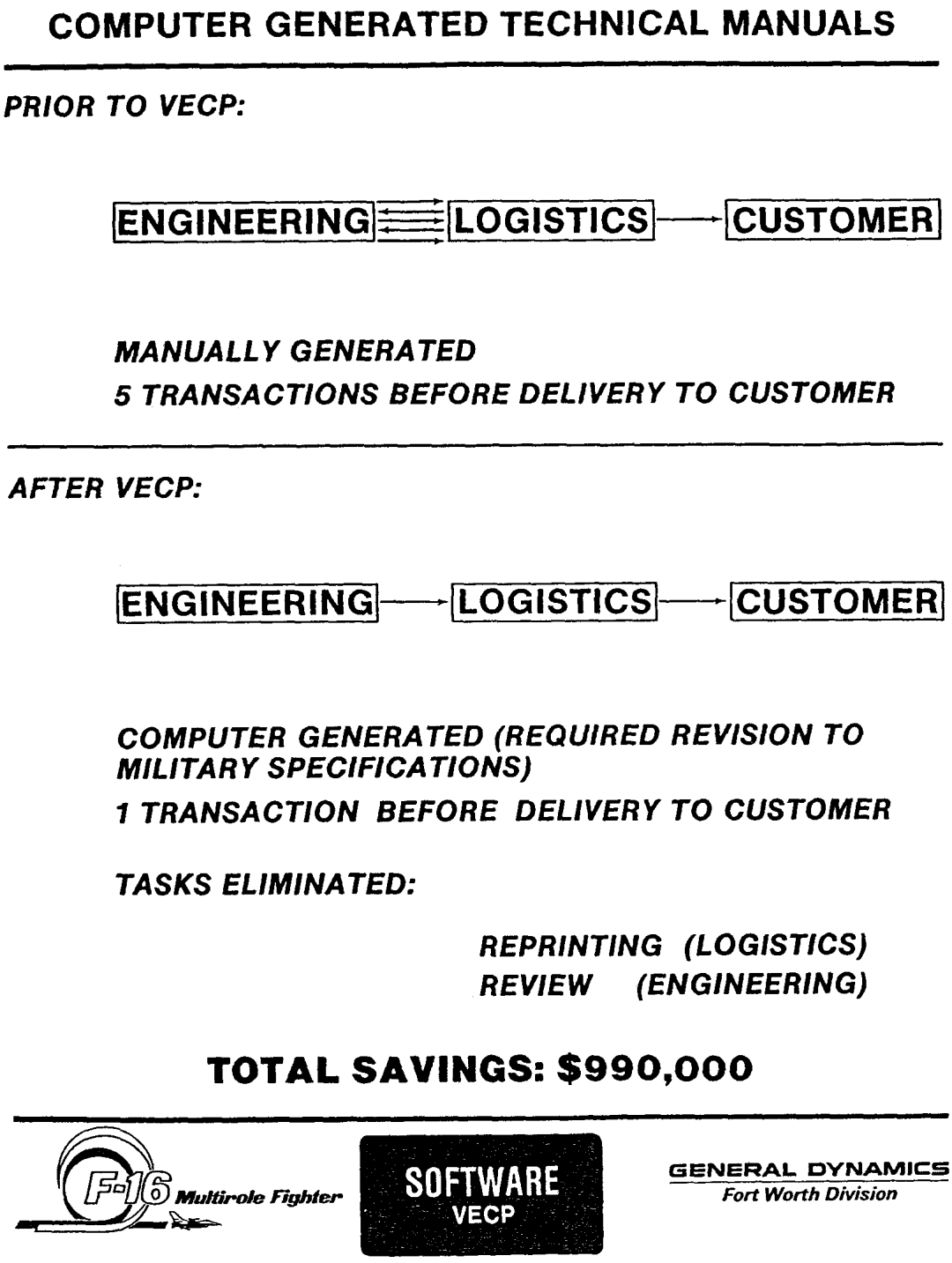
C9.1.14. Redesign of Fuel Pylons

Figure C9.F14. VECP 0668



C9.1.15. Computer-Generated Technical Manuals

Figure C9.F15. VECP 0875



C9.1.16. Men's Dress Shoes. A VE study conducted at Army's Natick Research and Development Laboratories focused on substitution of new materials for the leather in men's dress shoes. The substitution of synthetic rubber soles for the traditional leather soles resulted in a savings of $3 per pair of shoes. This savings translated into a $2,811,996 reduction in the cost of procuring the first year's requirement of these shoes for the Military Services.

C9.1.17. Automated Pay Data Requirements. At the Sacramento Air Logistics Center (SM-ALC), a review was made of the efforts utilized in collecting civilian pay related information by Resource Cost/Center Code. This procedure is needed to calculate the Civilian Fringe Benefit Factor, as required by OMB Circular A-76. Approximately 800 man-hours were required to collect and calculate the required information. An additional 30 hours was required to type the results in a prescribed format. A value analysis of the above methods and procedures resulted in a program designed for a particular minicomputer. This program eliminates manual data collecting and calculations, while printing the output in the prescribed format. Although this project only saved $10,118 per year at SM-ALC, it was recommended for Air Force-wide consideration.

C9.1.18. Drone Formation Control System (DFCS) To Control Multiple Ground Targets

C9.1.18.1. In order for the White Sands Missile Range (WSMR) to support the Assault Breaker Project, a system was required that could present as many as ten ground targets (tanks) in a remotely controlled configuration. The criteria the targets had to meet were that they should be separated by 50 to 100 meters, that their position be controlled with an accuracy of $\pm$ 10 meters or better, and that they travel a roadway as narrow as 15 meters. Since WSMR's capability to control ground targets was limited to manual remote-control of two vehicles, it appeared a new tracking and control system would be required. This would have meant a developmental effort and a rather lengthy, costly contract.

C9.1.18.2. A WSMR employee proposed modifying an existing system (i.e., Drone Formation Control System (DFCS)), which was originally designed to control aerial targets, in lieu of acquiring a new control system. The modified system provides the capability to track and control as many as 15 tank targets within the constraints described above. Twelve tanks are instrumented to provide two back-up (spare) units. The cost of acquiring a new system was conservatively estimated to be $2,811,000. The cost of modifying the DFCS was $285,000. This resulted in savings of $2,526,000.

AP1. APPENDIX 1

OFFICES RESPONSIBLE FOR VE WITHIN MAJOR DoD ELEMENTS

AP1.1.1. Office of the Secretary of Defense
DoD Product Engineering Services Office
ATTN: DPESO-XC
c/o DLA, Cameron Station
Alexandria, VA 22304-6183
Telephone: AUTOVON 289-2320
Commercial 703-756-2320

AP1.1.2. Department of the Army
HQ, DA (Office of the Comptroller of the Army)
ATTN: DACA-RMP, Rm 3B725, The Pentagon
Washington, DC 20310-2070
Telephone: AUTOVON 225-1768/1120
Commercial 202-695-1768/1120

AP1.1.2.1. U.S. Army Material Command
ATTN: AMCPD-SE
5001 Eisenhower Avenue
Alexandria, VA 22333-0001
Telephone: AUTOVON 284-6748/6750
Commerical 703-274-6748/6750

AP1.1.2.2. HQ, U.S. Army Europe/7th Army
ATTN: AEAGF-EMA
Office Deputy Chief of Staff Res Mgmt
APO New York 09403
Telephone: AUTOVON: Heidelberg
Military: 7415/8383

AP1.1.2.3. U.S. Army Communications Command
ATTN: CC-OC-MV
Ft. Huachuca, AZ 85613
Telephone: AUTOVON 879-6944
Commercial 602-538-6944

AP1.1.2.4. U.S. Army Forces Command
ATTN: AFCO-MD(G)
Ft. McPherson, GA 30330
Telephone: AUTOVON 588-5176
Commercial 404-752-5176

AP1.1.2.5. Office of the Chief of Engineers
ATTN: DAEN-RMV
Washington, DC 20314
Telephone: AUTOVON 285-0078/0462
Commercial 202-272-0078/0462

AP1.1.2.6. U.S. Army Training & Doctrine Command
ATTN: ATRM-MMP
Ft Monroe, VA
Telephone: AUTOVON 680-4438/2447
Commercial 804-727-4438/2447

AP1.1.3. Department of the Air Force
HQ, Air Force
ATTN: USAF/RDCA, Rm 5D263, The Pentagon
Washington, DC 20330
Telephone: AUTOVON 225-4167
Commercial 202-695-4167

AP1.1.3.1. U.S. Air Force Systems Command
ATTN: AFCS/PMDE
Andrews AFB, MD 20334
Telephone: AUTOVON 858-3251
Commercial 301-981-3251

AP1.1.3.2. U.S. Air Force Logistics Command
ATTN: AFLC/LOEP
Wright-Patterson AFB, OH 45433
Telephone: AUTOVON 787-2257
Commercial 513-257-2257

AP1.1.4. Department of Navy
Office of Naval Acquisition Support
ATTN: ONAS-054
Room 236, Crystal Plaza #5
Washington, DC 20360-5100
Telephone: AUTOVON 222-5885-0815
Commercial 202-692-0815

AP1.1.5. HQ, Marine Corps
ATTN: LMA-2
Commonwealth Bldg.
Washington, DC 20380
Telephone: AUTOVON 224-2606
Commercial 202-694-2606

AP1.1.6. Defense Logistics Agency
HQ, DLA, Technical & Logistics Services Directorate
ATTN: DLA-SE
Cameron Station (Rm 4A586)
Alexandria, VA 22314
Telephone: AUTOVON 284-6775/6779
Commercial 202-274-7132

AP1.1.6.1. HQ, DLA, Contract Management Directorate (CAS)
ATTN: DLA-AE
Cameron Station (Rm 8A398)
Alexandria, VA 22314
Telephone: AUTOVON - 284-7132
Commercial 202-274-7132