DEPARTMENT OF DEFENSE

Training Guide

# THE MANAGEMENT OF VALUE ENGINEERING PROGRAMS IN DEFENSE CONTRACTS

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Prepared for the

OFFICE OF ASSISTANT SECRETARY OF DEFENSE

(Installations and Logistics)

# THE MANAGEMENT OF VALUE ENGINEERING PROGRAMS IN DEFENSE CONTRACTS

## FOREWORD

The purpose of this Training Guide is to provide uniform instruction in value engineering program management for Department of Defense personnel. The text satisfies the requirements of those who will be engaged in negotiating, reviewing and approving contractor value engineering efforts. Additionally it will serve those who will have responsibility for value engineering program structure and operation within DoD agencies. The Guide presents the fundamentals of the value engineering theory and details of value engineering program tasks. Contractual aspects based upon the Armed Services Procurement Regulation are discussed in detail. Guidelines are offered for some of the administrative and operational facets of value engineering programs.

It is intended that this Training Guide will be used in conjunction with a formal course on this subject. The Guide contains case problem provisions for practical exercises in the application of the material. An examination has been prepared for use with the course. The examination, answers and notes on the case problems are issued as separate supplements. Satisfactory completion of this training will qualify personnel to organize, administer, procure and assess the effectivity of value engineering programs in industry and in the Department of Defense.

It has been found that a student's mental attitude toward learning has a significant bearing upon the amount of material he absorbs and retains. This Guide will be used by many who have been away from a formal educational environment for some time. The state of mind which exists during schooling is subject to change by work experiences. To gain the maximum

benefit from this material, it would help to consciously adopt the student's posture of receptiveness to learning. The prime purpose here is to learn; this will facilitate later adaptation of the subject matter in individual circumstances.

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An introduction to the subject of value engineering is provided by a survey of some highlights...the DoD Cost Reduction Program is discussed...its three major facets are examined...value engineering's role in this program is introduced by briefly describing its operation...organization in the DoD...and industry's posture...Past and current environmental cost pressures are noted...factors which influence the application of value engineering to end items are interpreted with respect to timing...type...and results...DoD value engineering documentation is briefly surveyed...the current ASPR...Specifications...Handbooks...and films are noted.

# CHAPTER I

# SURVEY

## THE DoD COST REDUCTION PROGRAM

Secretary of Defense, Robert S. McNamara, introduced the DoD Cost Reduction Program on 5 July 1962. He informed the President that logistics costs would be reduced by at least $3 billion per year within 5 years. He forecast a realization of approximately 25 percent of that goal in FY 1963 by improvements in operating efficiency. Results during the first year of the program proved that substantial savings could be achieved with no sacrifice in the national security. Notable increases in the number of nuclear warheads, ship construction, combat-ready Army Divisions, tactical air squadrons, airlift capabilities, and other measures of military effectiveness were made at reduced cost.

The Program was assessed in July 1963 after its first year. Mr. McNamara's estimate of total cost reductions by FY 1967 was then increased to almost $4 billion. The achieved results and these feasible goals are related to three basic approaches: a) buying only what is needed, b) buying at the lowest sound price, and c) reducing operating costs.

### Buying Only What is Needed.

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management control, the Navy has been able to reduce repair cycle time on high cost items from 90 to 45 days and on low cost items from 120 to 60 days.

Parts held in inventories by DoD agencies and contractors have led to worthwhile economies. Some examples are the transfer of excess Air Force rockets to the Army, excess Air Force jet engines to the Navy and the reclamation of parts for other than original use.

The elimination of costly materials and processes which are not essential to the proper function of the item being procured is another phase of the DoD program for buying only what is needed. An intensive review of specifications to accomplish this objective was underway as this Guide was issued.

Buying At The Lowest Sound Price.

Competitive Procurement. Maximum competition in procurement represents sound business policy. It is one of the most effective means of broadening the industrial base and ensuring that the lowest, sound price is obtained. The purchase of specialized military items occasionally involves unique problems which limit the opportunities for competition. The DoD is taking positive steps to expand the opportunities for competitive bidding on as many as possible of these specialized items. When the government is able to shift from a single source to a competitive procurement it has achieved price reductions on the order of 25 percent. Specific goals were established for each of the military services and the Defense Supply Agency for the percentage of their contract awards to be made by price competition.

Incentive Contracts. The weapons system concept and technological research advancements led to complex contracts from 1950 onward which were mostly cost-plus-fixed-fee (CPFF) type. The DoD and industry agree that CPFF contracts do not provide an incentive for economy. This type of contract does not intensify management efficiency with respect to the accuracy of cost estimates. The realism of procurement costs and budgets have suffered. Specific goals were established in 1963 for reduction in the use of CPFF contracts by each military service. Contracts which have incentives for better cost performance and penalties for overruns are being used to replace the fixed fee type.

Reducing Operating Costs.

Terminating Unnecessary Operations. One hidden cost in defense operations is the retention of unneeded real estate and facilities. The Office of the Secretary of Defense (OSD) is constantly reviewing the utilization of real properties. Wherever possible activities will be consolidated to eliminate redundant overhead costs, free personnel for higher priority duties and release property which could be put to more productive use.

Standardizing and Simplifying Procedures. During FY 1963, 16 different requisitioning systems were successfully consolidated into one standard system. This eliminated extensive rewriting of information and reduced the clerical effort. As a result, manpower efficiencies are increasing; over the next two years the clerical time alone will represent $20 million per year.

The DoD has introduced a single multi-purpose shipping document. It was designed to replace 81 different bills of lading and shipping forms. The value of the manhour improvement which the new system will represent when fully operational is estimated to be in excess of $30 million per year.

Consolidating and Increasing Efficiency of Operations. Some of the actions already taken to consolidate and increase operation of efficiency are:

a) The Defense Supply Agency. In its first 18 months of operation the DSA has produced results well beyond estimates prior to its creation. The DSA is now managing one million items of common supplies, and has proved its ability to provide effective support to military users at substantially less total cost than the sum of the previous individual costs.

b) Communications Systems. The responsibilities of the Defense Communications Agency have been expanded and its effectiveness improved. Consolidated procurement of leased line services, and more effective utilization of existing defense and commercial services have already produced significant results.

c) Transportation and Traffic Management. Savings have resulted from the continued use of economy class air travel, decreased cost of household goods shipments, and more economical use of airlift for cargo movements.

d) Maintenance Management. Detailed cost accounting and information systems have been installed to provide a basis for measuring and evaluating the performance of maintenance activities employing more than one million military and civilian personnel at some 2,000 locations.

Progress and Accomplishments.

When the DoD Cost Reduction Program was initiated in 1962, the cost reduction target for fiscal year 1963 was set at $750,000,000. This was the first planned step toward a FY 1967 cost reduction goal of $3,000,000,000 per year. At the end of FY 1963, the Secretary of Defense was able to report FY 1963 savings of $1,000,000,000; a 33 percent increase over the goal. Because of that excellent progress, the FY 1967 goal was increased from $3,000,000,000 to $4,000,000,000.

Large portions of these achievements have accrued from the plants of defense contractors and sub-contractors in response to the DoD program. In turn, as these economies materialize, they are being reflected in the DoD's annual budget to better meet the responsibility of national defense with the least possible demand upon the nation's resources.

## ROLE OF VALUE ENGINEERING

"Value engineering is a key element in the drive to reduce defense costs underscored recently by President Johnson." This statement by the Hon. Robert S. McNamara, Secretary of Defense, indicates OSD recognition and support of "...one of the best management tools that we know to place performance, schedule and cost in proper relationship." In his letter to Defense contractors on 2 Dec. 1963, Secretary McNamara stressed the use of value engineering. President Johnson's letter of the same date endorsed the Secretary's letter.

DoD Value Engineering Organization.

The role of value engineering can be illustrated by the capabilities and responsibilities which the DoD has organized. Management support and direction for value engineering program implementation has been provided by the Office of the Assistant Secretary of Defense (Installations and Logistics.) The Directorate of Productivity and Value Engineering, a responsibility of his Deputy Assistant Secretary of Defense (Equipment

Maintenance and Readiness) serves as a focal point for policies, procedures and program development.

A Value Engineering Council chaired by the Deputy Assistant Secretary of Defense (Equipment Maintenance and Readiness) has been established. As shown in Figure 1-1, each service, and the DSA are represented on the Council by their responsible value engineering office. The Council is able to provide coordinated guidance for conversion to meaningful action items.

A DoD Value Engineering Services Office has been established in the office of the Deputy Assistant Secretary. It has a staff of full time value engineering personnel. Their services are available to the DoD agencies for value engineering studies of specific projects.

Industry Organization.

The defense industry has reacted positively to the advancement of value engineering as a mechanism for increasing cost effective performance. Most of the major prime contractors, especially those heavily engaged in R & D, have installed value engineering programs. A focal point for responsibility is usually identified within these companies as the Manager or Director of Value Engineering.

The smaller companies, those which are usually in the role of subcontractor have been somewhat slower in developing this capability. This has been partly due to lack of adequate value engineering contractual provisions for subcontracts, and partly due to lack of development of operating procedures suitable for these smaller companies.

Operation.

One purpose of this Guide is to illustrate the details of the value engineering mechanisms for achieving DoD goals. However, a survey of the general operational aspects is in order here to introduce the subject.

There are three mechanisms used to gain the desired results. Value engineering as a theory is offered as a method of analysis for all cost determining personnel. Their application of the principle of functional cost evaluation in daily work decisions leads to preprocurement assurances that only basic needs will be obtained and at the lowest sound price.

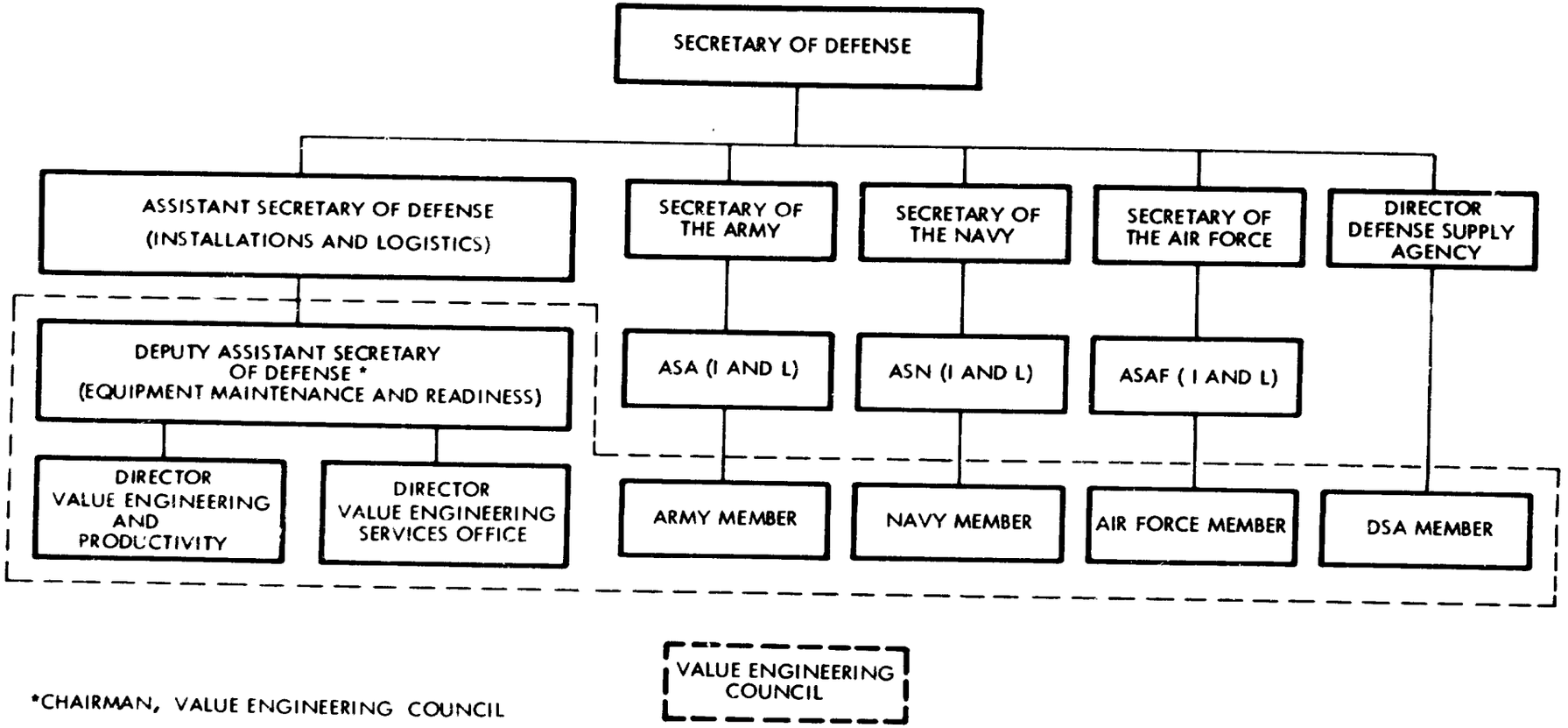


Figure 1-1. DoD Value Engineering Council—Organizational Location

A series of tasks are established to support the use of the method by all personnel. They are specific applications of the theory to facets of defense inventory procurements which are known areas of significant cost contribution. As an identified value engineering program, these tasks identify and isolate any element whose cost is not commensurate with its worth. This leads to the elimination or improvement of poor value items.

The third generalized mechanism is assignment of personnel to be solely concerned with value engineering. These people have two main responsibilities: a) to assist the previously discussed cost determining personnel in their application of the theory and, b) to perform cost reduction studies of selected items.

ENVIRONMENT

Value engineering is a commercial industry development of the mid-1940's. It was called value analysis at that time and was applied mostly to high volume hardware items after their design was completed, and sometimes even after production had started. Its purpose was primarily to increase profit. The incisiveness of the theory was recognized and adopted by elements of the DoD in the early 1950's. Since then it has been promulgated throughout the defense industry, the DoD and other Government agencies.

Department of Defense Usage.

Early applications of value engineering within the DoD resulted in higher value items, but occasionally the implementation costs prohibited using the results. Changes to defense inventory items approved for service may entail expenses for changes to manuals, re-procurement of new spare parts, stocks of two kinds of spare parts and updating records and data. This fostered the development of value engineering techniques that would be applicable to the R & D phase of acquisition. The use of these methods prior to production avoids unnecessary initial expenditures. The DoD environment today provides opportunities for the application of value engineering to many existing items and the capability to assure value during the early acquisition phases.

Cost Reduction Pressures.

It is not realistic to say that value engineering, per se, should not be necessary and, therefore, contractors should not receive any benefits for doing it. The past use of CPFF contracts in defense procurement has been previously cited for its lack of economy incentives. CPFF also does not provide an incentive for the individual personnel in industry to reduce costs. Many of the CPFF procurements were for research and development. This involved a high percentage of the nation's engineering and support personnel. Therefore, many personnel associated with defense inventory items today have background experiences generated in an environment that was not positively oriented towards cost conservation.

Personal Factors.

Cost incentive contracts are now prevalent and an individual's cost performance influences his company's final profit. The DoD has responsibility for spending public funds. Each installation and its personnel are under scrutiny for its cost effectiveness performance, as well as its functional performance. Companies and military agencies have intensified the monitoring of individual cost effectiveness performance. Military directives have been issued which state that cost effectiveness performance is a factor to be considered in preparing personnel rating reports.

APPLICATION

End Items.

The daily operation of value engineering is concerned mostly with assemblies and detail parts rather than with entire systems. Its concern is during their conception, development, prototype fabrication, production, installation and operation. The scope includes the nonhardware cost contributing elements of data and documentation associated with the hardware end items. Some non-hardware examples are: a) the preparation of technical manuals, b) establishment of requirements for data, c) report preparation, and d) preparation of engineering drawings. It can find application in the facilities or architectual and engineering (A & E) field. The principles are applicable but it must be during the early stages before the "mortar" has set. Maintenance of military equipment offers many opportunities for the application of the value engineering method.

Value engineering operates mostly on the personal level with those decisions which an individual finds under his sole control. It does not usually include decisions, such as, whether a nuclear-powered aircraft constantly aloft provides a more cost effective deterrent than a Polaris submarine on station.

Timing.

The use of value engineering must consider the point of application in the life cycle of the material involved. There are various acquisition cost factors which constrain the practicality of value engineering application. Generally, as a design matures and its configuration firms, the accomplishment of value engineering cost reductions becomes more difficult and more expensive. There is a point in the acquisition cycle at which an ostensible reduction in acquisition (or procurement) cost might mean an overall cost (acquisition plus installation, operation and logistics) increase. Value engineering in early design and development phases can achieve maximum cost avoidance because changes can be implemented without offsetting production and logistics costs.

Defense inventory items are frequently re-procured over a span of several years. This provides an opportunity for taking another look. Some of these opportunities are offered by the re-procurement of items that satisfy their requirements even though they may not be doing it for the best value. Also, the passage of time permits taking advantage of commercial processes that were laboratory curiosities when the initial procurement was made.

Type.

In addition to selecting the appropriate subject and establishing the point in time that is suitable, the type of application must be determined. The Armed Services Procurement Regulation (ASPR) permits two types of contractual application of value engineering in industry contracts. The contractor may be paid a direct sum of money and is required to develop and implement a value engineering program on a particular contract; or he may not be required to do anything. But, if he does perform successfully, he will be given a share of the resultant cost reductions. Application within the DoD requires selecting the proper program tasks as discussed in Chapter 4.

**Results.**

The results of value engineering efforts are both direct and indirect. The objective of value engineering is the improvement of value which may be (and usually is) obtained by the reduction of cost. Direct results are the achieved cost reductions which can be unambiguously measured. However, a significant portion of value engineering achievements are joined through the efforts of personnel other than designated value engineering personnel. Their results are not always clearly distinguishable nor immediately evident. This is not to say that they are not real. The development of value engineering and the resultant application to the early design phase have produced results which are more easily and realistically measured in units other than dollars. There is, for example, an improvement in a company or military office cost-consciousness atmosphere. This is a highly desired result, since the lack of this atmosphere is an environmental factor that has contributed to the need for the subject. Indirect benefits also result from increasing the capability of personnel to produce a more cost-effective product than they might otherwise do.

Direct results frequently occur in other than cost units: a) improvements in reliability, b) improvements in ease of supply, and c) increases in the opportunity for competitive procurement. These other factors, although real, tend to be subordinated to claims of savings.

## DoD DOCUMENTATION

Several Government agencies prior to 1959 recognized the existence of value engineering programs. DoD documentation has proceeded from allowable use of value engineering to the present regulations which are written in terms of mandatory requirements. Contract clauses now provide for contractor sharing in all approved value engineering change proposals. This places the burden upon the contractor to generate proposals to reduce the acquisition price of a contract but provides industry with an appropriate gain.

### Armed Services Procurement Regulations (ASPR)

The ASPR is derived from the Armed Services Procurement Act of 1947. It is under the cognizance of the Assistant Secretary of Defense (Installations and Logistics). The primary purpose of the ASPR is to

enact a complete and uniform set of procurement policies to be used by all services and subordinate organization of the DoD.

ASPR on Value Engineering. Revision 45, dated 20 April 1959, contained the first ASPR contractual provisions for value engineering. It set forth a value engineering incentive clause and described it as "experimental in nature." Command approval was required for its use. On 15 March 1962, Revision 8 to the ASPR was released. It removed the approval requirement and provided a limited description of the value engineering principles. It was not explicit in application criteria. Revision 13, dated 31 December 1962, provided definite value engineering clauses for three different contractual situations:

a) A value engineering incentive clause which allowed the contractor to share in cost reductions that accrued from proposals be submitted.

b) A value engineering program requirement clause which obligated the contractor to maintain value engineering efforts in accordance with an agreed program.

c) A value engineering program requirements clause with value engineering incentive provisions that became operable only after the contractor had saved a sum of money that was a multiple of the cost of the required program.

Except for construction contracts, a value engineering incentive was to be included in all fixed price and cost plus incentive fee contracts of $100,000 or more that did not contain a value engineering program requirement clause or the combination clause.

Revision 3, dated 15 November 1963, is the latest ASPR on value engineering at this time. It has provisions for only two types of clauses:

a) A value engineering incentive clause which provides for the contractor to share in cost reductions that ensue from accepted change proposals and

b) A value engineering program requirement clause which obligates the contractor to maintain a value engineering effort in accordance with an agreed program. It provides for limited sharing in all cost reductions that ensue from accepted change proposals.

These provisions shall be included in all advertised and negotiated procurements in excess of $100,000. They are stated as not applicable for inclusion in procurements for construction, research, or exploratory development. The ASPR is discussed in depth in Chapter 5.

Value Engineering Specifications.

When a contract has a value engineering program requirements clause, the contractor is obligated to perform definite tasks to a specified level of effort. A specification, in one of its many forms, is the usual method of delineating the requirements. Several of the military services have released value engineering specifications. Elements of the services have issued value engineering program descriptions for particular acquisitions, especially weapons systems. These documents have had varying degrees of success in accomplishing the contractual objective. The DoD was in the process of preparing a unified Value Engineering Specification at the time of publication of this Guide. It will present a set of value engineering program tasks for the contractor to satisfy the program requirements clause. The program elements presented in Chapter 3 of this Guide are typical of the anticipated specification requirements.

Handbooks and Manuals.

Elements of the DoD have issued value engineering handbooks and manuals usually oriented towards the issuing agencies' needs. They usually present value engineering in its hardware orientation and discuss the history, Job Plan, and what value engineering can do. In a few instances they touch upon specific tasks. On 29 March 1963, the DoD released Value Engineering Handbook H-111. It is non-directive but provides guidance on many key facets of value engineering such as: methodology, target setting, item selection, costing, reporting and the interfaces with other techniques such as PERT.

The present state-of-the-art permits more comprehensive coverage than was possible at the time of H-111 was prepared. Techniques have been developed and the scope has been enlarged. This Guide will, therefore, present much data not in H-111.

Films.

The DoD has released DoD Cost Reduction Film (OSD7-63). Each military service has produced a film on value engineering. "More Ships for Less", is the Navy film; the Air Force produced "The 100 Million Dollar Story" and the Army made "More for Your Money" These films present some value engineering accomplishments and examine some of the value engineering techniques. They are familiarization rather than training films.

## SURVEY: SUMMARY

A. The DoD Cost Reduction Program is currently in operation and is producing significant economies by three basic approaches: a) buying only what is needed, b) buying at the lowest sound price, and c) reducing operating costs.

B. Value engineering helps obtain cost reductions by: a) providing a specific method for all cost determinant personnel to use in daily operations, b) serving as a base to establish and perform identified tasks to isolate areas of low value, and c) using assigned personnel to perform value studies of selected subjects.

C. Value engineering application usually is on items under the decision control of an individual, such as detail parts and assemblies, rather than choices between alternate weapons systems.

D. Value engineering is applicable to software items of data and documentation as well as to hardware.

E. The results of value engineering efforts include direct cost reductions which can be accurately measured and indirect benefits of increased cost effectiveness capability which may not be immediately apparent and which are difficult to isolate for expression in monetary units.

F. Authority and direction for value engineering inclusion in defense contracts is found in Part 17 of Section I of the Armed Services Procurement Regulation.

# CHAPTER 2

# PRINCIPLES

## TERMS AND DEFINITIONS

There is at present a number of definitions of value engineering in existence. The growth of a discipline involves the participation of many people in widespread areas. The pace of individual technical progress frequently exceeds the communication that leads to standardization.

This Guide will express the value engineering nomenclature by considering three of its aspects. First, the theoretical or disciplinary aspects; second, the value engineering program; and third, the personnel who are engaged in value engineering. None of the definitions provided in this document are dogma; none are intended to represent the only definition, or even the best definition that could ever be devised.

### Value Engineering Discipline.

The value engineering discipline is an analytical process of identifying needed functions and establishing the minimum cost to provide those functions in order to maximize end-item value. Broadly stated, it is the theory of the method. It is a discipline that is cost-reduction oriented. By definition it is an analytical process; it involves probing and evaluating in order to improve understanding. The words "needed functions" convey the meaning that value engineering is concerned with what is to be done and the reality of the need for doing it. For example, the value engineering theory seeks minimum cost by considering various methods of achieving the function rather than by considering ways of reducing cost of a specific method which leave it substantially unchanged.

Value Engineering Program.

A value engineering program is an organized set of definite tasks which support or apply the value engineering discipline in all elements of an organization that affect cost. The word "organized" is significant. Unless planning, scheduling, measurement and other control procedures are applied, one does not have a value engineering program, or any program. "Definite tasks" indicate that the program elements must be stated (and understood) in sufficient detail to be logical entities which can be assigned, manloaded, costed and assessed. The phrase "in all elements of an organization" indicates that the existence of a value engineering effort in an isolated section of an installation would be unlikely to qualify as a value engineering program.

Value Engineering Personnel.

These are designated individuals who have been trained in the value engineering discipline and who have responsibility for its application. These personnel should have "Value Engineering" in their job description, classification, title, or whatever is appropriate in their organization. Specialty value training should be in the person's background. The definition also states that to qualify as "value engineering personnel," one should have responsibility for application. The most desirable form for this responsibility is as full-time effort.

Value.

There is greater common understanding of the word engineering than there is of the word value. The dictionary has several definitions of value. The ones that best fit the value engineering situation are: "relative worth, utility, or importance; degree of excellence; a numerical quantity assigned or computed." Value in this usage is measured in the eyes of the beholder. It is a relative and subjective item. Firm and definite rules for its measurement are not available. It must be borne in mind in relation to item value, current applications or needs.

Use Value. The economics discipline has subdivided value into many types. These include the value an object may possess because of its ability to do something. This is referred to as its use value. It represents the properties and qualities which accomplish work or service. Use value includes all of tne performance requirements which are necessary for the item to perform its intended application at the needed time.

Esteem Value. This represents the properties, features, or attractiveness which create a desire to be known to possess the article. An item may have little or no use value and yet have a significant esteem value. An example is the use of real jewelry in a play instead of costume jewelry, The costume jewelry would perform the same minor use but it would not have the same esteem value to the actress.

Aesthetic Value. Esteem is different than the value ascribed to an item simply because it is beautiful. The worth of appearance is called aesthetic value.

Exchange Value. Another value which can be recognized is exchange value. It measures the properties or qualities which will remain attractive enough to other people to permit resale in the future. Exchange value is demonstrated by the trade-in book value of automobiles.

Cost Value. The cost value of an article represents the summation of various costs required to produce it. It can be measured and expressed in dollars by the seller.

Price and Value. The formerly elusive parameter, value, can now be qualitatively approached. It can be approached quantitatively if in addition to identifying the values offered by an item, an equivalent dollar amount is assigned to each value. The sum of the dollar worths of the values offered by an article must be equal to or less than the price of the article (viz., cost value) for the purchaser to say, "That is a fair price." Buyer and seller may disagree on the worth of the values present in any article.

The value engineering approach to Department of Defense items is that the use value should equal or exceed the cost value. Esteem, aesthetics and exchange values are negligible compared to use. The value of an end item approaches its maximum if its cost is made up solely of features which contribute to its use and do not include any factors which contribute cost towards esteem, aesthetics, or exchange. A value engineering goal is the maximization of end item value through the control of use value and cost value and the elimination of costs associated with any other value.

Function.

As noted previously, the value engineering discipline deals with the functions of items. Function is used here to mean the action for which a thing is specially fitted, or used, or for which it exists. The value engineering approach is to be concerned first with what the item is

supposed to do--only afterwards with the item itself. For example, before considering a fabrication method improvement for a certain part, the realism of the need for the function should be satisfied, and then other ways of performing the item's function should be investigated. The consideration of function is the fundamental skeletal structure of the value engineering method.

Value Analysis, Value Control and Value Management.

The Department of Defense makes no distinction between the terms value analysis and value engineering. Furthermore, the Department of Defense contractually speaks of value engineering. Value Control and Value Management are terms used by some companies to describe their value programs. This Training Guide will use the term value engineering and it may be considered synonymous with the others mentioned above.

Value Assurance.

The term value assurance will be used in this Guide to indicate the application of value engineering during the initial creative phases of an item; for example, during design or procedure preparation. Its efforts are intended to assure a high value item when released for fabrication or when placed in service. It has its parallels in reliability assurance and quality assurance.

Value Improvement.

Value improvement will be used in this Guide to refer to the efforts applied to an already existing serviceable article to recreate one of better value. Broadly stated, it is an after-the-fact approach.

ANALYSIS OF FUNCTION

The fundamental element of the value engineering discipline is the analysis of function. It is the means of relating use value to performance with positive consideration of cost.

Description.

The functions of hardware and software may be analyzed at any stage of their existence. When applied during the conceptual stage it deals with the requirements for which a hardware item or document is being sought. The term "item" is used in this Guide to cover both the conceptual and

post-release situations. The functional analysis procedure involves the treatment of three facets of an item and its possible alternatives or solutions: a) function, b) worth, and c) cost. Each parameter is determined, evaluated and compared. Subjective impressions are used in the process; judgment must be exercised. Functional analysis as discussed here bears some similarity to systems engineering of weapons systems.

Function.

Functions can be expressed, categorized and handled just as any other descriptive element of an article, such as its weight, length, or color. There are several good definitions in current use for this term. For this Guide, functions may be thought of as the features that an item possesses, or that constitute its performance. They are traits of tangible hardware parts as well as of documents and procedures.

Function Format. Functions are expressed as two-word abridgements of the performance features involved. The use of only two words, a noun and a verb, assists in achieving a high degree of summarization of the performance feature. It forces an exact statement of the problem, which in turn helps provide a broad opportunity for solution.

Thus the common screwdriver would be said to "transfer torque" rather than to "drive screws." True, it can be (and is mostly) used to insert or to remove screws. But the common screwdriver would not work if it did not transfer the twist of the wrist to the screw head. It is that transfer that must be attained. If the handle of the screwdriver slips around the blade tang, no force is transferred, the screw doesn't come out, and the function is not performed.

Basic Function. Functions can be divided into two types, which are here labeled basic and secondary. Basic function is defined here as the performance feature that must be attained. In the case of the screwdriver, transfer torque would normally be the basic function. If the major performance feature was something other than associated with the driving of screws, the basic function might be something else. For example, if the desired application were the prying open of paint can lids, the function would be in terms of the transfer of a linear force rather than a rotational force.

The establishment of basic function is relative to the requirement. A clear understanding of the real need for the requirement is necessary if clarity of basic function definition is to be obtained. An item may possess more than one basic function. This would occur where one item provides several performance features that need to be accomplished.

Secondary Function. Secondary functions are also performance features that are possessed by an item other than those that must be accomplished. Secondary functions represent those features whose existence is necessary to the performance of the item but are attributed to the method chosen to perform the basic function.

Thus a screwdriver may also be said to "insulate energy" if it has a plastic or rubber handle. This would be a secondary function if the handle material was chosen to increase the friction between hand and handle, that is, to facilitate performance of the basic function.

The handle itself, regardless of its composition, may represent a secondary function in another situation. Viewed from the requirements side the basic need is to drive screws. If a hand-operated screwdriver is chosen to perform this basic function, the handle function is secondary. It exists only because the device called a screwdriver was chosen to perform the basic task. If a coin, or a thin flat blade, like a spatula blade, were chosen, there would be no handle. The screwdriver handle provides a support feature necessary for it to perform the basic feature of driving screws when held in the hand and twisted.

Functional Relationships. It is common practice in dealing with hardware to describe them as elements of next larger assemblages and as constituted themselves of several smaller subparts or as nondivisible without losing their identity. The relative position that an item occupies in the scheme of total assembly is called its indenture. Indenture levels below the "top" assembly are developed and assigned as design proceeds.

The significance of indenture to this subject is that the designation of functions as basic or secondary depends upon the indenture level of the antecedent item. A function which exists to support the method of performing the basic function is a secondary function. But, when considered by itself with respect to itself, it is a basic function.

For example, the surface of the screwdriver handle that increases friction is secondary with respect to the screwdriver as a hand rotated device. But, if the surface of the handle is considered with respect to the handle, increased friction is the main performance feature that must be attained. Therefore, it is a basic function of the handle as a first indenture level item.

Application to Assemblies of Parts.

Some hardware items that appear to be uncomplicated have many levels of lower indenture. The rule for functional evaluation is to work from the top down and to consider the project under study as the top assembly. Perform the analysis of function upon the top assembly first. Only after assurance that the objectives of value engineering cannot be achieved at the top assembly level should the first indenture parts be studied, and so on, down to the lowest level of indenture.

For example, if the screwdriver were under value improvement study, attempts to improve the handle would be subordinated until it was determined that: a) performance of the function was needed for the application in question, and b) a manually rotated, spade-bladed device was the best approach.

Conservation of Function. Functions may be used as rough measures of cost effectiveness. This guideline is a rule of thumb that will generally hold true, but must be applied with good judgment. The value of an item approaches its maximum as unneeded functions are eliminated and as the number of secondary functions is reduced.

Worth.

The second step in functional analysis is to establish a dollar figure for each needed basic function. This is done after the functions have been identified and typed and any unnecessary functions have been discarded. Worth is the cost estimated to be a reasonable price to perform the function. The estimate is made by the person or team doing the functional analysis.

Procedure. The quantitative aspect of worth is a subjective element in value engineering just as it is in any setting. Consumer consideration of whether to repair an old washing machine or to buy a new one and the

decision of whether to buy a new set of golf clubs at a very good price when the old set is still serviceable are examples of the worth category of decisions which are made frequently. These are usually made or strongly influenced by a "what is it worth?" consideration. A point is reached in the deliberation of purchase decisions when one concludes, "not at that price; but if it were this price, it would be worth it."

Unfortunately, most of us are more adept at doing this exercise for consumer goods than for defense items. But it can be done for both. Some of the questions that might be asked for setting the worth of function are:

A. What is the cost of achieving this function,

   1) if some other known piece of hardware is used?

   2) if it had been done as some prior program?

   3) if it were being done in commercial industry?

   4) if it is bought from a competitor?

B. What price would you pay if it was your own money that you were spending?

C. Is this a common function of every day accomplishment or a rare thing of difficult performance?

D. What is the price of some item that will,

   1) almost, but not quite, perform the function?

   2) do the function plus several others?

All of the above factors are guides, but experience and judgment must also be applied to set the worth of function. The procedure needs further development to increase its accuracy. At this moment, however, it can be performed well enough to serve a useful purpose. It is probably the most difficult step in the entire value engineering process. It is also one of the most useful.

Application. The establishment of a dollar figure for the worth of each needed function is a major goal of the value study. It is one boundary of the value aspect of the overall problem. The selection of one of several alternatives is facilitated by comparing the cost of each to the

worth of the functions that need to be accomplished. It thus serves a threefold purpose: a) a test for value, b) an element of evaluating decisions for approval, and c) a factor for measuring the effectiveness of value engineering efforts.

Cost.

The consideration of cost is the third step in functional analysis. As mentioned above, the magnitude of cost as compared to worth is a measure of value. In this application, it is the cost of the method chosen to perform the function that is considered. Worth applies to function; cost applies to the physical method of achieving function.

Determination. Cost may be determined by one or more of several processes. The choice depends upon the item's design completion status and previous procurement. Records should be searched for historical cost data. The cost estimating, pricing or analysis organization can be requested to derive a predicted cost for items under development and for alternatives being evaluated. Vendors may be requested to make quotations. In any event, it is the future cost for the quantity in question that is to be used. Past actual costs must be adjusted to reflect the future.

Application.

Functional analysis is performed as one of the early steps in the value engineering method. Its use is summarized in Table 2-1. The method and the output is the same for all application; the use of the results varies according to the item under consideration.

THE JOB PLAN

The Job Plan is a series of tasks whose performance constitutes the accomplishment of a value engineering study. Each step entails one or more elements necessary to the satisfactory conclusion of a value engineering study.

Significance.

The Job Plan is a key component of the value engineering process. It has been found in practice that its formal use is instrumental in achieving best results from value engineering studies. Excessive informality with

Table 2-1. Application of Value Engineering Functional Analysis

| Activity | Apply To | To Find | Express As | Identify For Further Use |
|---|---|---|---|---|
| Project Selection | Specific item of hardware or software. | a) Need for improvement<br>b) Value status | a) Function(s) needed<br>b) Worth of function(s)<br>c) Cost of item | Ratio of cost to worth |
| Value Improvement Studies | Project | Data for improvement action. | a) Function(s) needed<br>b) Function(s) provided<br>c) Worth of basic function(s)<br>d) Cost of item | a) Unnecessary function(s)<br>b) Cost/worth ratio for each basic function<br>c) Number of secondary functions. |
| | Possible Alternatives | Data for selection decision. | a) Function(s) provided<br>b) Cost of items | a) Cost/worth ratios<br>b) Number of secondary functions. |
| | Selected Item | Support data for proposal recommendation | a) Function(s) provided<br>b) Cost of item. | a) Improvement of the cost/worth ratio<br>b) Function(s) discarded<br>c) Variation in number of secondary functions. |
| Value Assurance Activities | Problem to be solved or requirement that is to be met. | Data to assist in selection of solution. | a) Function(s) required<br>b) Function(s) needed<br>c) Worth of function(s) | a) Unnecessary function(s)<br>b) Worth |
| | Possible Alternative Solutions | Data for selection decision | a) Function(s) provided<br>b) Cost of solutions | a) Cost/worth ratios<br>b) Number of secondary functions. |
| | Selected item or Solution | Support data for decision approval. | a) Function(s) provided<br>b) Cost of item | a) Cost/worth ratio<br>b) Function(s) discarded<br>c) Number of secondary functions |

respect to economic aspects has been found to contribute to a low value environment.

The diligent use of the Job Plan provides:

a) A vehicle to carry the study from inception to conclusion.

b) A convenient basis for maintaining a written record of the proceedings.

c) Assurance that consideration has been given to facets that may have been neglected in the creation of the original article.

d) A logical separation of the distinct portion of the study into units that can be planned, scheduled, manloaded and assessed.

Application.

The Job Plan is used in training for the project work exercises and in actual practice for value engineering studies. As presented in this Guide, the Job Plan pre-supposes selection of an item for study. Some expositions include this in the Job Plan itself. The project must be selected in any case; the exclusion of project selection permits easier application during training.

As presently structured, the Job Plan is oriented towards value improvement studies. Its method and much of its content are also applicable to value assurance. A strong similarity exists between the Job Plan and the general process that is usually followed during hardware design, test procedure preparation and other activities of daily performance.

Personnel.

The Job Plan is used whether the study is being done by a group or by an individual. Each member of a team need not separately perform the entire Job Plan. Individual assignments of some tasks may be made; these areas will be noted as discussed below and presented in more detail in the section on Task Forces in Chapter 4.

Records.

A written record should be maintained of the actions taken and the data gathered. When a Task Force is in operation each person who performs a separate assignment should provide the others with a summary of his results. The value engineering member of a Task Force usually serves as its secretary.

D. Proposal Phase

1) Determine recommendations

2) Prepare written report

E. Implementation Phase

1) Follow up and assist in the implementation of recommendations

2) Verify predicted cost data

Information Phase. This is the first step in the Job Plan. Its objectives are to: a) obtain a complete understanding of the project supported by factual knowledge, and b) establish the criteria against which possible improvements will be compared.

The first objective is gained by gathering information. (For training exercises much of this should have been performed in advance and provided to the team). This task is suitable for assignment of separate parts to individual team members. The data gathered should be supported by tangible evidence in the form of copies of the applicable documents. Typical information which should be obtained includes the following (the type of project will influence the final choice):

A. Design

1) Drawings

a) Layout

b) Fabrication

c) Assembly

d) Control

e) Interface

2) Specifications

3) Background of previous design decisions

4) Schedule

5) Tooling

B. Customer and Contractual Requirements

1) Quantity and Schedule

2) Specifications

3) Application

4) Incentives

5) Procurement potential

6) Previous procurements

7) Proposal Data

8) Change procedure and requirements

C. Fabrication and Test

1) Make or buy data

2) Tooling data

3) Manufacturing planning

4) Schedule

5) Vendors or subcontractors

6) Reject or scrap rate

7) Quality program

Method.

The method of applying the Job Plan is to follow each phase in sequence. It will be more apparent later, especially when tried for the first time, that the phases are highly dependent upon each other. Therefore, it will occasionally be found necessary to return to a previously completed phase for additional data needed for a downstream decision.

Judgment must be exercised to determine the depth to which each phase should be performed before proceeding to the next step. A trade exists between doing work that may turn out to be unnecessary and jeopardizing the complete success of the following phase due to incomplete performance of the precedent. This judgment is a skill factor that is improved by experience.

Phases of the Job Plan.

As noted before, the nomenclature of value engineering is not universally constant. Most, if not all, of the differences are not significant enough to be an issue. Especially in a training mode, it is the understanding of the intent that is the prime objective. This Guide presents the Job Plan in five steps or phases:

A. Information Phase

1) Gather facts

2) Analyze functions

3) Prepare cost model

4) Set cost target

B. Speculative Phase

1) Develop possible alternative solutions

C. Evaluation Phase

1) Analyze alternatives, compare with the criteria

2) Determine implementation costs

3) Select most likely alternative

4) Verify adequacy of selected alternative

8) Test procedures and past results
9) Packing and shipping
10) Sample item
11) Process specification

D. Cost Data (input to and as defined by cost model)
1) Historical actual cost
2) Estimated future cost
3) Proposal cost
4) Contractual cost

When facts supported by documentation cannot be obtained, personnel opinions or interpretations must be sought. The best source should be used. For instance, contracts personnel are better qualified to interpret the contract than the designer; written reject records can provide data that the foreman might have forgotten or that might have occurred before he came on the job; manufacturing planning sheets may show several intermediary operations not contemplated by the engineer.

The second objective, to establish the criteria for later comparison with alternatives is gained by: a) analysis of function, b) preparation of a cost model, and c) setting cost targets. Functional analysis has been discussed in the preceding section. If the study is a team exercise, all members should participate in the performance of the functional analysis. The preparation of the cost models and cost target may be assigned to an individual. All team members should be given copies of the models and should concur with the target.

Speculative Phase. The objective of this phase is to develop possible solutions to the value problem. Consideration of solutions should not formally begin until the problem, as defined during the Information Phase, is well understood. All team members should take part in the execution of this phase.

The choice that is selected by the study, and hence, the results of the exercise, will probably be generated during this phase. The generation of alternate approaches to performing the needed functions may be done by several problem solving systems. If the item under study has more than one feasible solution, the likelihood of finding the best one increases with the number of possible solutions generated.

Formal use of the creative problem solving process is suggested to produce possibilities other than those that might occur spontaneously or

by any other process. Techniques for its application to this sort of problem are discussed in the Department of Defense Training Guide for the Principles and Applications of Value Engineering.

Evaluation Phase. In this step the choices developed in the preceding phase are sifted and examined to arrive at a final recommendation. The process involves a verification of the probability of satisfactory substitution for the subject under study. This will probably not be required in detail for each of the generated alternatives, since many of them will be disqualified after a superficial examination. But the most likely candidates should be subjected to the following operations which may be performed by separate members of the study team:

A. Functional Analysis
B. Detailed Cost Estimate
    1) Unit cost
    2) Implementation cost
    3) Contract cost effect
C. Technical Adequacy Status
    1) No testing required, or
    2) Testing required
        a) schedule
        b) cost
D. Change Procedure Requirements

The assessment of the above data should indicate a most likely choice. Two selections may be made if the analysis doesn't provide a clear decision. For example, an alternative which requires an extensive testing program may be recommended together with another choice which offers a lower cost reduction but which does not require verification.

Actual testing is not usually a part of the value engineering process, per se. Simple or inexpensive testing may be "fitted in" as the Job Plan is followed. The value engineering objective is to analyze, study and recommend for action. Neither its budget nor its capabilities are usually structured to provide engineering verification.

Proposal Phase. In this phase a report is prepared of the study activities, results and recommendations. Each team member should contribute a portion; each need not prepare a separate report. The report, called here a value engineering proposal, is to the authority or agency which convened the group or authorized the study. Additional distribution of the report should be made only by its recipient.

The report should be prepared in the style and consistent with the standards of good technical writing. Three special considerations may be noted:

a) A one page summary of the entire report should be the first page of the report. It should contain the highlights of the study, the recommendations and a concise treatment of the cost data.

b) The flavor and tone of the report should be carefully chosen to avoid alienating other personnel. No matter how tendered, the value improvement recommendation is a criticism. It is offered constructively, but it is sometimes received otherwise.

c) Complete back-up details of names, prices, sources, document numbers, etc., must be provided. The implementing personnel should be able to readily locate key information.

Implementation Phase. The responsibility of a team is discharged when the report is issued. Attainment of the overall objective, however, is not reached until the recommendations are converted into actions. Assigned value engineering personnel should remain active on the study until it is implemented or has been satisfactorily disposed. Assistance may be needed in the change procedure, re-verification of elements of the proposal, provision of further back-up data, etc. The actual costs of implemented studies should be determined for comparison with the proposals.

## PROJECT SELECTION

Project selection deals with choosing items for specific value study. It is a different situation than the application of value engineering principles in daily routine. Project selection seeks to isolate and identify items for intensive value engineering application. The question can be asked: "How is one to know that an item can be value engineered?"

### Identification of Values.

The process for selecting hardware and software projects suitable for value engineering involves the application of criteria in order to assess the items rating as good value or poor value. The answer lies in the identification of the values which it possesses in terms of use, esteem, etc., and the cost contribution for each of these values. A broad brush functional evaluation of cost and worth will provide a measure of confirmation of value status.

Probability of Implementation.

Another parameter that should be involved in the selection of projects is the probability of successfully incorporating changes. Certain factors need to be considered here which may vary between projects and programs. One of these is the state-of-the-art that a particular item represents. The likelihood of improving items which have been subjected to many cost reduction studies during a long life certainly is less than that of newly developed items which have probably not been intensively studied for their value engineering aspects. The local atmosphere about changes is a factor that will affect the success probability. Another consideration that can be involved is the level of technical knowledge concerning the project which is available to the persons performing the study.

Schedule.

The effect upon the article's schedule should be considered. At the hardware level of value engineering application it is seldom justifiable to sacrifice schedule for cost reduction. Some past experiences have indicated that value engineering application may improve procurement lead times. In any event, potential cost reductions should be examined to see if schedule changes might be justified.

Total Potential Cost Reduction.

The total cost consequences of a particular study must be evaluated before the study is to be made. This includes a rough order of magnitude estimate of the likely possible cost reduction that is achievable in terms of the quantity and the present cost of the item. The likely implementation costs must be estimated by rules of thumb and experience factors. This will help decide if a particular project offers enough potential to make it worth the study. An item of high unit cost may offer less potential than an item of lower cost which will be used in larger quantity.

Worth of Study.

The length of time (hence, the cost) required for investigation, study and action to arrive at the point of change may negate the overall reduction of its cost. Additionally, each time an item is value engineered and re-value engineered, the actual dollar cost reduction diminishes. Expressed

as a percentage, it may remain constant or even increase. In all cases, it should be assured that the return is worth the investment.

Other Aids.

The total combination of its representation as good or poor value, the probability of successful improvement, the effect upon schedule, and the cost consequences provide a logical picture of whether a project is fertile or not. The performance of these tests is a matter of the skill and experience of the personnel involved in them. There are aids for determining these parameters. If PERT or PERT/Cost is in use on a program, it will help provide the cost and schedule consequences of variations in the timing of the program. Learning curves are helpful for evaluating changes in production. Some cost analysis techniques are available which give rough order of magnitude assessments of item cost related to a physical or performance parameter. Cost target systems discussed in Chapter 3 identify items during their development that are candidates for value study. Computers can be a valuable tool to identify items for study. Computers already in use at many Department of Defense procurement, supply and maintenance activities can be programmed to provide a print out when an item is in a "buy" position in sufficient time to permit study prior to re-procurement.

## PRINCIPLES: SUMMARY

A. The value engineering discipline is an analytical process of dealing with needed performance functions to achieve best value by providing these functions at minimum cost.

B. A value engineering program consists of an organized set of tasks which support and apply the value engineering discipline in the elements of the organization that influence end item cost.

C. The values present in any item may be identified, measured and used as an indication of price reasonableness.

D. The value engineering approach for defense inventory items is to obtain use value at minimum cost and to eliminate factors which contribute cost to aesthetics, esteem, or exchange.

E. The scope of value engineering application includes hardware and non-hardware items of the entire Department of Defense inventory at all stages of their acquisition and usage that offer cost reduction potential.

F. The application of value engineering requires the analysis of functions, the assessment of their relative need and the comparison of their worth to the cost of their achievement.

G. The worth of each basic function is established as the criteria to test the cost of various methods of accomplishing the basic functions.

H. Formal accomplishment of the steps in the Job Plan will assure comprehensive consideration of the key elements of value engineering application.

I. The selection of an item for value engineering study depends upon its value rating, probability of successful improvement and the anticipated return on investment (the cost of study).

# CHAPTER 3: PROGRAM ELEMENTS

A value engineering program consists of separate tasks appropriate to its application. . . this Chapter describes seven of the most likely individual elements for use in DoD and Industry value programs. . . The mechanics of performance. . . application. . . personnel. . . inputs and outputs are presented for Value Training. . . Value Studies. . . Task Forces. . . Cost Targets. . . Value Reviews of Designs and Specifications. . . Materiel Value Program. . . and Project Requirements Assessment.

# CHAPTER 3

# PROGRAM ELEMENTS

The value engineering theory may be utilized in various formats as needed by the using agency of the project to which it is applied. Specific tasks which have a direct bearing on the achievement of an organization's overall value engineering objective will be called the program elements. They are separate and identifiable portions of the total task of achieving best value in defense products. Selectively combined they satisfy DoD program requirements for value engineering.

This Chapter describes most of the program elements in use today. The choice for specific applications will depend upon the magnitude, acquisition phase and type of items involved. This Chapter will provide the details of performance that will enable one to make the appropriate choices. Each of the elements can be described, manloaded, scheduled, and assessed. Selection from the program elements in this Chapter will also provide a base for incorporating value engineering in contract work statements. Additional program elements may be developed for special requirements and as the state of the art advances.

All of the task elements involve participation by value engineering personnel in their establishment or in their performance. However, primary responsibility for several of them may reside with other functional areas of the organization with support assistance from the value engineering group. Satisfactory accomplishment in these cases may depend upon the availability of value trained personnel.

## VALUE TRAINING

The accomplishment of cost avoidance during the design and development phases of a product's life cycle rests primarily with the personnel directly involved with creating that product. Training in definite methods and disciplines of value engineering will improve their capabilities to operate on cost stimuli, at the same time imparting a value climate of proper balance between technical and economic considerations. Value training is equally important in other phases of a product's life. Operating personnel with responsibilities for reducing existing product costs need to acquire skills in the value engineering techniques. Training is the basic element of a value program at this time.

The value engineering skills and techniques are presently either nonexistent or rare in the undergraduate curricula of colleges and universities. Until they become available and personnel come to industry and the DoD with this education in their background, it will be necessary to provide "in-house" instruction.

### Trainee Selection.

To maximize the accomplishment of value engineering in all organizational elements, training exercises should include attendees drawn from the various line and staff functional groups which have value responsibilities. This attendee "mix" will vary and should be periodically reviewed to assure that trained personnel are located within each major functional area. The interface between the DoD and its contractors may be improved through value training programs. When representatives of subcontractors, contractors and government agencies participate together in training programs, additional communication benefits develop.

### Types.

Value training programs may be classified as two major types - orientation and workshop. Both types are essential to a well operated value training effort.

Value Orientation. This type of training includes familiarization sessions which range from one to eight hours. They are designed to acquaint attendees with value engineering fundamentals, goals, and general operating methods. These sessions are especially appropriate for personnel whose

primary responsibility would not require attendance at a full-scale workshop seminar. Upper-level managers, senior staff personnel, field operations, draftsmen, and laboratory technicians are examples of individuals who would attend this type of training.

The content, length, emphasis and format of the presentations included in these orientations must be matched to the particular audience. Certain basic features, however, are common:

a) Principles of value engineering theory
b) Examples and case histories
c) The structure and operation of the value engineering program
d) Contractual aspects
e) Responsibilities of the audience towards the value program

Workshop Training. A workshop or workshop seminar, is an intensive training exercise commonly of 40 to 80 hours over 2 to 4 weeks. It's content includes lectures in techniques and methodology and combines this instruction with team project work. It provides the opportunity for application of the theory in a controlled environment. Value engineering effectiveness is demonstrated by project work participation, personnel communications are improved by exposure to new contacts, actual cost improvement proposals are generated by the project exercises, and personnel with special capabilities and interest in value work are identified.

Facilities. Adequate facilities are an important consideration for workshop seminars and orientation sessions. Presentations should be made in a lecture-type room with comfortable seating, good lighting, ventilation, and low noise level. Workshop seminars need thirty to forty square feet per attendee of total floor space for tables, seating, displays, and reference materials.

Curriculum. The curriculum for value engineering training should be especially structured to fit the areas of application that the participants are most likely to find for the techniques that they learn. For example, the training aids and some lecture material appropriate to personnel engaged in fuze development would be inappropriate to personnel normally engaged in aircraft maintenance. Project office personnel who extensively interface with industry need more material on contractual aspects and industrial cost estimating than research laboratory people. It must be

planned in advance and staffed with capable instructors and guest lecturers for specialty subjects. Lectures should provide a combination of:

a) Basic instructional and background material.

b) Enthusiasm and interest-generating motivation.

c) Variety of presentation, e. g., a number of different speakers.

d) Variety in program -- lectures, audience participation, films, discussion, exhibits, project work, etc.

Personnel. Three types of personnel, other than the attendees, are usually involved in a value engineering seminar: a) lecturers, b) guest speakers, and c) project leaders. The lecturers, from two to five, provide the direct discourse on value engineering principles and allied matter such as creative problem solving. Guest speakers may be used to cover the specialty areas of in-house disciplines which touch on value considerations. These may include contracts, finance, technical specialties, logistics, price analysis, and etc. Project leaders work with from one to three teams to provide guidance and stimulation during the project work portion of the seminar.

The lecturers must combine an understanding of their topic with the ability to communicate. Their function is primarily to educate. They do not all need to be va' engineering personnel, but it is desirable that they have previously attended a seminar. Guest speakers should be experts in their field. Familiarity with value engineering and lecture capability are necessary. Project leaders must have previous value engineering experience. They should be able to keep the team energized. Members of a value engineering group usually perform well as project leaders.

Priority of Attendance. Conflicts between the pressures of normal work assignments and seminar attendance should be resolved prior to the selection of participants. Administrative directives and personal contact with attendees and their supervisors are suggested to resolve problems in this area. Regular attendance at workshop seminars is important for the trainee.

Timing. Workshop seminars may range from 40 to 80 hours. In some cases half-da' sessions have been found to be desirable. In this manner normal job continuity may be maintained over the seminar period.

Less than half-day sessions are inadequate, and less than two weeks for the seminar makes it difficult to obtain vendor quotations. In any event, the total calendar time between the first and last sessions should range from two to four weeks.

Attendees. The optimum class size will vary according to the organizational needs and availability of experienced team project leaders, but should not exceed fifty. The larger groups require very careful planning of project work and vendor coordination to assure adequate coverage for all teams. Attendees for each seminar should be drawn from line and staff functional groups, including engineering, procurement, manufacturing, finance, quality, project offices and others whose job performance has a significant effect upon product cost.

Project Work. Chapter 5 of the Principles and Applications of Value Engineering provides details of this subject.

Vendor Participation. To acquaint participants with the suppliers' role, a limited number of vendors (from five to fifteen) may be invited to participate in the seminar. An appropriate format is to invite the vendors to send two representatives, one technical and one cost estimating type, with a small display of their product or process. Vendors should be selected which are appropriate to the workshop projects. A portion of the project time should be set aside for the team members to discuss their projects with the vendors in attendance.

Value Personnel Training.

Basic training for value engineering personnel is the workshop seminar. It provides an excellent opportunity for him to demonstrate if he has an inherent interest in and talent for value work. It needs to be complemented by further training and experience in his specific area of application and related disciplines before the individual is fully effective. Designation as a value engineer should be predicated upon an academic degree or the equivalent in years of experience in related fields. With that as a baseline, further development should include demonstrated aptitude in a workshop seminar, proficiency during a period of on-the-job training, and attendance at one or more related courses. A number of universities have suitable specialized courses and offer certificate programs for the professional designee.

## Training Responsibility

The administration and operation of a value engineering training program is normally a joint responsibility of the value engineering group and the training group. The distribution of this responsibility will depend upon the workload, major tasks and manpower availability. Regardless of the exact distribution, it is important for both groups to be involved so that each will provide its specialized talents. In organizations with no training group, the entire effort will be within the value engineering function.

Typical responsibilities for value training are:

Value Engineering Responsibility. The value engineering group will:

a) Formulate the technical aspects of the curriculum.

b) Provide appropriate speakers and related visual aids material.

c) Provide team projects, project leaders, and necessary supporting data.

d) Provide technical support.

e) Follow-up project work for possible implementation.

f) Assess the effectiveness of the training in the organization's value engineering program.

Training Responsibility. The training organization will:

a) handle arrangements for facilities, equipment, and services,

b) conduct the seminars,

c) measure the effectiveness of the activity and provide feedback data to value engineering,

d) assist in the selection of participants.

## VALUE STUDIES

The value study is the basic operating mechanism of value engineering personnel. It entails the performance of value assurance or value improvement efforts on specific projects. The projects may be selected as a portion of this task or they may have been identified by other task elements such as training, cost target programs and value reviews. Value studies are usually done by an individual who follows the process already described

by the Job Plan. He obtains information and special assistance from personnel in other areas of the organization as needed.

Procedure.

The value studies task involves five steps: a) project selection or verification of projects identified by other activities, b) making the study, c) reporting of recommendations, d) implementation assistance, and e) results verification. All of these have been previously discussed in detail. The input to this task is likely projects from which choices are made and the output is a report of recommendations. By-product outputs may be summary reports of resultant action by the personnel responsible for implementation and verification of achieved cost reductions or cost avoidances.

Application. This task is suitable for application to hardware and software items for almost all areas of DoD usage. The main criterion for applicability is the existence of potential for cost reduction. The performance of value studies requires the full time availability of at least one value engineering personnel. Each step of the Job Plan generates periods of relative inactivity while waiting for cost estimates, quotations and technical verification analyses; consequently, one value engineer can perform several studies simultaneously. Value studies will usually require from four to ten weeks from start of the Job Plan to issuance of the study report. Implementation timing and action are dependent upon the personnel responsible for and with the authority to take action on the study recommendations. However, the value studies schedule should make provision for time to follow-up each report.

TASK FORCES

Description.

The task force is a mechanism for applying value engineering in the workshop training seminar and in practice. Personnel are designated to deal with an assigned value problem, usually within a definite length of time. It represents a formal team approach to the study of a specific item as opposed to performance by an individual who informally obtains special help as he feels he needs it.

The group exercises provide:

a) mutual demonstration of the reality of each members' contributions to and effects upon value.

b) a heightened sense of personal stake in the value engineering proposal's final disposition.

c) improved communication among the team members and their work organizations.

Structure.

A value engineering task force is composed of four to seven members. Each member is selected from a different organizational element. Every task force should have representation from: a) production, b) engineering, c) procurement, and d) value engineering. Additional personnel are chosen from other disciplines that are significant determinants of the project's value.

The nature of the project (hardware or software; electronic, chemical, motor oil or clothing) will guide the selection of team members. At least one of the task force members should be competent in the project's major technical specialty. All, or at least most, should have had value training. Task forces may include the originator of the project, especially if it is his opinion that the article can be improved.

Operation.

The use of task forces as an element of a value engineering program should be supported by in-house documentation which describes how the following operations will be managed.

Formation and Disbanding. The individual in authority whose approval will be required to create a task force is significant to the actual operation of the value engineering program. The initiating authority needs to be at a level that can make personnel assignments from the various organizational units that will be represented on the task force. Although the authority for the day to day operation of the task force will normally be delegated to the head of the value engineering organization, the initiating authority should be the one that disbands the group.

Inputs. A task force should be provided with:

a) Name and organization of the members.
b) Particular project as their assignment.
c) Background of the projects selection.
d) Schedule for completion.
e) Designation of the task force leader.
f) First task force meeting date, time and place.
g) A definite goal.

At the first session the team should be given the documentation and samples pertinent to their assignment. In actual practice, the teams may be expected to do more information gathering than in the training mode. Value engineering personnel normally do the pre-meeting preparations.

Performance. The task force follows the Job Plan and performs a value engineering study. As previously discussed, each member need not separately perform every step of the study. Hence, the task force need meet in group session only for those elements of the Job Plan which require team effort. As a minimum requirement, regular weekly meetings of the entire team for one or two hours should be held during the task force life.

The value engineering member has the following responsibilities during a task force study:

a) Serve as the team specialist on the project's value aspects.
b) If not acting as chairman, serve as the task force secretary.
c) Coordinate the preparation of the study report.

Output. The visible result of a value engineering task force is a report of its recommendations. The report should be structured as described in the Job Plan discussion of Chapter 2. Some intangible benefits accrue from the cooperative team effort which are not directly assessable. The task force is normally disbanded after its report is accepted by the initiating authority.

Post Task Force Activity. The value engineering personnel are responsible for following the team recommendations to implementation and verification of the final disposition. This effort is similar to the final phase of the Job Plan.

Application. The use of task forces would be suitable as an element of a value assurance or value improvement program. Its application normally occurs after a project has been identified and selected by any of the methods noted in Chapter 2. Task forces tend to make more efficient use of the value engineering personnel. One value engineer should be able to serve about three simultaneous team studies. The creation and successful operation of task forces depends upon the resources of value trained personnel in the operating elements from which team members are drawn.

## COST TARGETS

A cost target program is a method of using predicted cost data to obtain positive consideration of fabrication (or acquisition) cost during the design phase. A cost target is a feasible dollar amount preset as a desired goal for specified elements of an item's fabrication cost. It is not the item's total cost and it is not a contractual or negotiable number. Cost targets for individual hardware items should not be confused with the target cost of incentive contracts.

Cost target program operation identifies the individual items of hardware that need value study at one or more points prior to their release for production. The program structure should provide for this isolation to serve as input and stimuli for corrective action by engineering, value engineering, task forces or other responsible elements of the value program.

Application.

The following situations are a guide to selecting applications for cost target programs. In all cases economics must be examined as the final test:

a) R&D programs which contain fabrication of sufficient hardware dollar volume to justify the application.

b) Production procurements or re-procurements of previously designed items when time is available or will be devoted to their improvement prior to fabrication.

c) Production programs of sufficient time duration to permit study and redesign and timely implementation.

Cost target efforts are normally applied to the hardware. They provide coverage for those documentation items that are closely associated

with the targeted hardware. Although the basic procedure is applicable to software, this Guide will reflect its past major usages on hardware.

The cost target application to a given contract may be only for a portion of its hardware. Some, but not all, of a program's hardware may justify treatement. Partial application will also cost somewhat less than full application, though not at a linear rate. Guidelines for selecting items are provided below.

Procedure.

The operational procedures of a cost target program must be tailored to the using agency or program. However, a broad description can be provided. The procedure is characterized by an iterative feedback of a predicted cost for an end item at several discrete points (for example, design reviews) during the design process. Each feedback provides an under-target, over-target, or on-target signal. Over-target items become the subject of intensive value study (for example, by task forces); under-target items are evaluated for possible reduction of the target. No action is taken for on-target conditions. Final evaluation of the program effectiveness is performed when the verification point, usually a delivery point during fabrication, is reached. At that time, the achieved actual cost of each targeted item is compiled in the same structure as the basic cost model which was used to prepare the cost target.

Selection of Items. Not all programs, or all items on a program, are amenable to cost targeting. The selection should be made as early in the program as possible. Various criteria may be employed in making the decision:

a) The total estimated item production cost is high enough to warrant its share of the cost of the targeting effort.

b) The items represent the lowest level of indenture which is assigned to an individual designer.

c) Development and testing is involved rather than off-the-shelf selection.

d) Recent developments indicate a potential opportunity for cost reduction.

e) Previous experience with a given type of item indicates a pattern for its actual production cost to exceed its porposed cost and (a) above also applies.

f) The assigned designer has had previous difficulty in achieving cost effectiveness.

g) The future use of the item depends upon significant reductions in cost.

h) Cost prediction and accumulation of actual cost are possible.

The levels of indenture at which targets are assigned may depend upon the extent to which the hardware is defined. It may be necessary to target end items progressively down through the indenture levels during the preliminary design phase as the hardware nomenclature is definitized.

Selection of Monitoring Points. Monitoring points are the discrete milestones at which formal comparisons are made between the item's predicted cost and its cost target. These may coincide with one of more of the following: a) design reviews, b) design engineering inspection, c) pre-production release reviews, and d) pilot or prototype completion. They should be selected to achieve a balance between the capability to prepare meaningful predicted cost estimates and the time remaining to make value studies and to take corrective action. The accuracy of predicted cost estimates varies inversely with the time remaining to accomplish cost avoidance. For this reason at least two, and preferably three, successive monitoring points prior to design release should be selected. Those programs which will involve production periods of about a year or more should have a monitoring point early in their production phase. The point of five percent or ten percent production run completion may be appropriate. The law of diminishing marginal returns will help to determine the last feasible date for monitoring. Once monitoring points are established, they should be published as a part of the master program schedule.

Selection of the Verification Point. The verification point is the discrete occurrence for which the cost targets are structured. For example, the cost targets may be set for the cost of the tenth deliverable item or for the average unit production cost. The actual cost is determined as of the occurrence of the verification point. The difference between the achieved cost and the cost target (over, under, or equal) is indicative of the cost effectiveness performance It could also be reflected in the fee or profit of incentive contracts.

Setting Cost Targets. Cost targets are created by assigning dollar values to each major cost element of the item. The cost elements which are included should be those over which the 'action level' personnel may be logically expected to exert some measure of control. For example, overhead and various administrative cost elements are not directly reducible by the designer and should not be included. Another criterion under which cost elements may be excluded from the model is if they represent a negligible or undefinable portion of the expected or proposed cost of the end item. The cost model process is useful for preparing the cost target structure.

After the elements are selected and the structure is defined, the actual target dollar amounts are set. The targets should be less than the originally estimated cost which was used to compute the contract cost. This provides a cost reduction goal.

There are several possible bases for generating the dollar assignments. They may be some arbitrarily fixed percentage less than the proposed cost. The functional analysis approach of establishing the least cost to perform the required functions may be used. A desired cost, which is related to the price adjustment formula of an incentive contract, could be used. The system selected may be a combination of any of these.

The cost target for the top assembly of a hardware unit of several indentures may be synthesized as the sum of the created subassembly targets created individually for the lowest indenture levels. The converse approach may be used; a cost target is created for the top assembly and is then apportioned downward among the subassemblies. Each subassembly target is then distributed among its detail parts downward through the indenture to the previously selected lowest level for targeting.

Each user must analyze and determine the most effective approach. However, the following criteria must be satisfied for each established cost target:

a) The cost target should be attainable.

b) The responsible action level personnel (designer, production engineer, procurement specialist, etc.) should participate in target establishment.

c) The responsible designer should understand the basis for and the use of his cost target

Monitoring. The monitoring phase starts after the cost target has been assigned. It consists of predicting the cost for the design under consideration and comparing it with the cost target. The variance between the predicted cost and the cost target is considered at the design review or other formal approval points.

A Target Cost Event Chart may be used to communicate the cost target status for each targeted item. Progress in achieving cost reduction goals can be monitored by these charts. Each responsible individual receives an updated chart for his item at each monitoring point. Figure 3-1 is a Target Cost Event Chart for a typical end item at program completion. It shows the necessity for, and the results of, two task forces (in this case) and the final relationship of the achieved cost to the original target.

## VALUE REVIEWS

Value reviews as a program task element includes the efforts which lead to and provide for the formal approval of designs, specifications, or procurements. For example, Design Reviews would become Design Value Reviews upon the incorporation of value engineering as an element of the review and approval process. Design and Specification Value Reviews may be combined. This Guide will discuss value reviews in the design context. However, the methodology is applicable to many other procurement or in-house decision situations.

The value engineering responsibility includes: a) determination of the reviews to be held, b) generation of the procedures for them or, the incorporation of value engineering considerations into existing procedures, c) performance of the value engineering analytical effort preceding the reviews, d) review board representation, and e) the generation of checklists to be used by the design or specification personnel in assuring their consideration of value engineering requirements as preparation for review board evaluation and approval.

Value Design Review.

The purpose of the design review function is to verify that the design approach being taken will best fulfill defense needs. It is an organized, formal effort, implemented at major milestone points during development, guided by the technical standards and the specified requirements. The

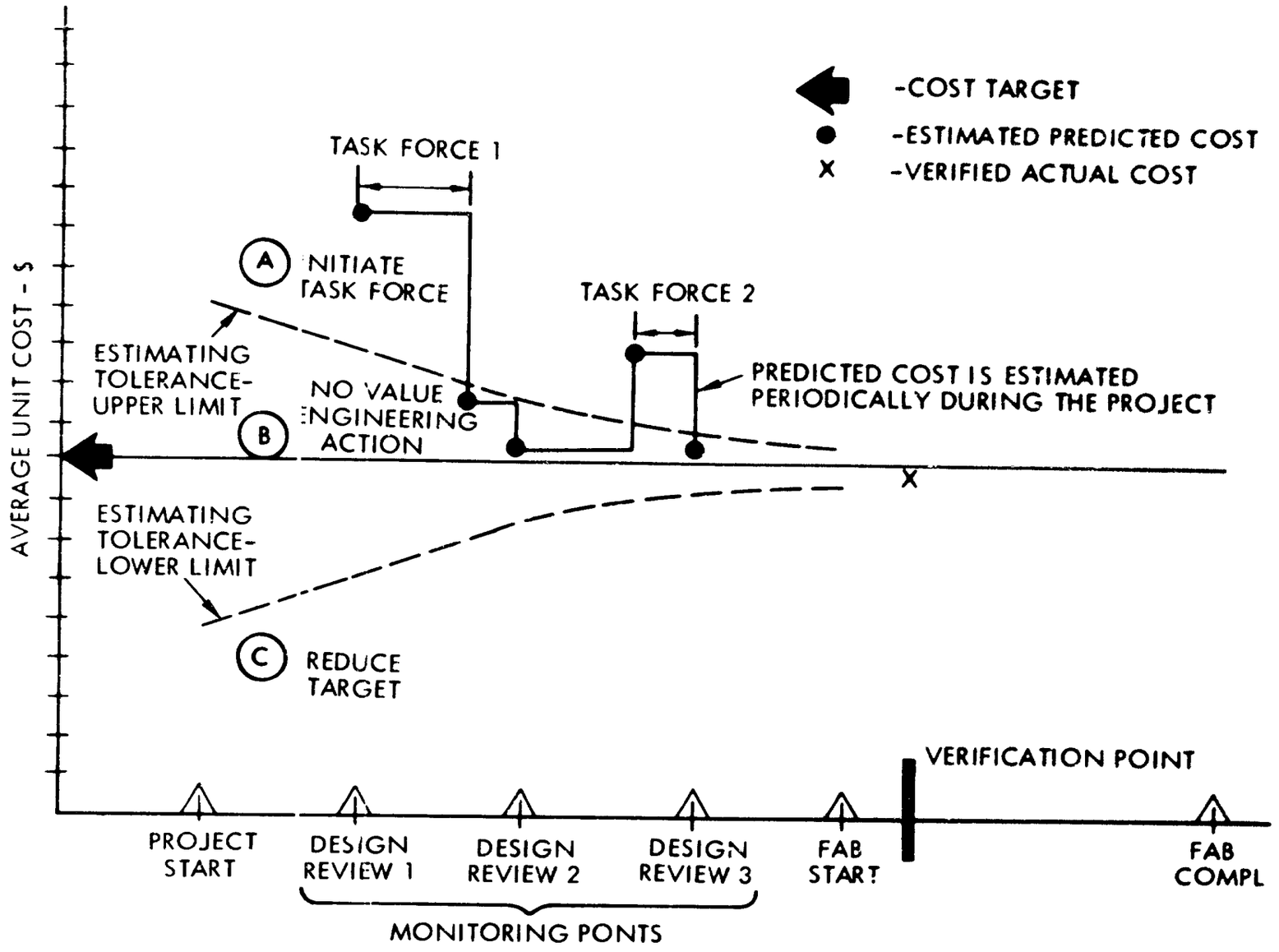


Figure 3-1. Target Cost Event Chart

value design review has provisions which increase the attention presently given to economic aspects.

Application. The design review procedure is normally applied to hardware during the R&D phase. A Design Review task statement or specification may be in existence at the installation or may be found in contracts awarded by the installation. Value design review requirements may be placed in the agency's value engineering program regulation or other description.

Procedure. Specialist personnel individually review the design drawings and other data. This is followed by a joint discussion of identified problems which leads to the assignment of action items for resolution. For maximum effectivity, most of the participating specialists should not have been directly involved with the creation of design under review. For value design reviews, one of the specialists may be a value engineer.

Value design reviews may occur: a) wholly within an industrial contractor or DoD organization, b) as a joint effort of a contractor and the procuring agency, or c) as a joint effort of a contractor and one or more subcontractors.

Economic Considerations. A value design review places special emphasis upon the economic aspects of the design. Some of the cost facets which should be considered during a value design review are:

a) Identification of an initial cost target for each design "package."

b) Comparison of a cost estimate for each design alternative with the cost target.

c) Establishment and discharge of responsibility for cost control.

d) Determination of the prices and price breaks of purchased parts.

e) Solicitation of cost reduction ideas from design review team participants.

f) Functional analysis of the design requirement and the design alternatives.

Management Directives. Management participation in the design review program is a prerequisite for the development and issuance of effective value design review directives. This support is manifested when:

a) Specific responsibilities are designated for their conduct

b) Authority is delegated for their conduct, e.g., a Value Design Review Monitor is appointed.

c) Requirements and procedures are established for design data distribution.

d) Value Design Reviews are scheduled in the master program plan.

e) A procedure is set for Value Design Review Committee membership.

f) Post-review responsibilities are assigned.

The directives and procedures are implemented under responsiblity assigned to a Value Design Review Monitor who:

a) Schedules review milestones.
b) Follows up on action items generated at the reviews.
c) Publishes design review status charts.
d) Mediates interdisciplinary differences.
e) Reports on review progress and effectivity.

Timing of Value Design Reviews. The number and timing of value design reviews are a function of design maturity. The nomenclature indicates their place in the schedule. Four may be found necessary and labeled as: a) conceptual, b) technical, c) major and d) final. Some organizations use three, called: a) concept, b) layout, and c) detail. Some call the detail review the package review. The number and timing are determined by the completion of the concept data, the detailed layouts and schematics, and lastly, the completion stages of detail drawings, specifications, test data, etc.

Value Engineering Role. Presence of value engineering personnel on the review team may be specified as an element of the value engineering program. His presence and tasks provide assurance that consideration for cost effectiveness is being given to every element of design. This objective will be accomplished by analyses before the Value Design Reviews and inputs to them.

At the time of the reviews, the value engineer should have a concise summary of up-to-date events and projected goals for the remainder of the program. Specifically this summary should include:

a) Existing and potential problem areas and recommendations for their resolution

b) Completed and in-process value studies.

c) A functional analysis of the item.

d) A list of high cost areas and specific recommendations for minimizing cost.

e) Cost target data on the item.

f) Predicted cost estimates of the alternative approaches under consideration.

Small programs and installations often cannot justify sufficient value engineers to provide full time coverage of all reviews. The major portion of available time should be spent concentrating on the high cost areas during the conceptual and technical stages.

Design Review Check Lists. A wide variety of value check lists have been made available for use with reviews; their use should be mandatory. Formal use of check lists provides a means of approaching the intent of the Value Design Review at minimum cost. Check lists need to be structured for the particular type of product to which they will be applied. Thus, there might be an Electronics Assembly Value Check List or a Missile Air Frame Value Check List. Additionally, separate check lists may be needed for conceptual and final reviews. The degree of their effectiveness is directly related to the seriousness of consideration which members of the Value Design Review team give to them. This is one reason that the creation of a cost-conscious environment must have personal attention. A brief example of some possible check list elements is given in Table 3-1.

Table 3-1. Typical Value Design Review Check List.

General

| | | |
|---|---|---|
| 1. | Have the specifications been critically examined to see whether they ask for more than is needed? | Yes ___ No ___ |
| 2. | Has the cost of any overdesign been defined for its effect on production as well as on the R&D program? | Yes ___ No ___ |
| 3. | Has the cost effect of contractually-required overdesign been discussed? | Yes ___ No ___ |

Table 3-1. Typical Value Design Review Check List (Continued)

4. Has the field of commercially available packaged units, subassemblies, and circuits been thoroughly reviewed to be sure that there are no standard vendor items that will do? Yes___ No___

5. Have suggestions been invited from prospective suppliers regarding possible value improvement from loosening specification limitations? Yes___ No___

6. Does the design give the user what he needs and no more? Yes___ No___

7. Could costs be radically reduced by a reduction of performance, reliability/or maintainability? Yes___ No___

Parts Selection and Evaluation

1. Have appropriate standards been consulted for selection of standard components? Yes___ No___

2. Can a redesign omit a nonstandard part or replace it with a standard part? Yes___ No___

3. Have all nonstandard parts been identified and approved? Yes___ No___

4. Has the design been coordinated with similar designs, circuits, parts or components to benefit from past experience? Yes___ No___

5. Are the standard circuits, standard components and standard hardware the lowest cost standards which will supply the minimum required characteristics? Yes___ No___

6. Can the use of each nonstandard part of circuit be adequately justified? Yes___ No___

7. Can any new nonstandard part be replaced by a nonstandard part which has already been approved? Yes___ No___

8. Do control drawings leave no question that a vendor standard part is being specified when such is intended? Yes___ No___

9. Has standardization been carried too far so the cost of excess function is greater than the gains resulting from high quantity? Yes___ No___

Responsible Designer _____ Date _____

Integration with Cost Targets. If the value engineering program includes a cost target program, this program should be integrated with the Value Design Review activity. The cost target that has been developed as a design requirement is compared with the estimated costs of the design alternatives under review. This will not only provide a more accurate measure of the cost effectiveness of the particular unit being studied, but also will show the cost variables that affect related designs, indicate any necessity for additional value study and help support the Value Design Review decisions.

Specification Value Review.

Every product has a specification of some kind. Many specifications, especially equipment specifications, incorporate requirements for use of one or more standards. An equipment that consists of several hundred components which is made by several processes and uses many different materials may easily involve hundreds of specifications and standards. However, the complete equipment can be obtained as a unit with one specification that describes the overall requirements.

Industry and government have classed specifications with adjectives such as performance, design, test, manufacturing, procurement and many others. Standards are identified by a name to indicate the issuing or controlling source. Depending on the complexity of the product and the intentions of the originator, any or all of the different types may be used to design, produce, test, and perhaps of greatest importance, prove that the item "works," and, therefore, is acceptable. Specifications are directly responsible for costs. They may be a primary source of poor product value and a primary obstacle to value improvement.

Specification Realism. Over specification leads to unrealistically high requirements that call for capabilities unlikely to be used, are expensive out of proportion to their contribution to final product performance, and may be obtainable only by compromising more useful capabilities. Under specification leads to failure in use. Yet, while specifications may be faulty, they are presently indispensable. If a specification demands capabilities that exceed the actual use requirements, an economic risk is incurred. This is because some units of production will fail to pass specifications, yet by virtue of a safety margin in the specifications, may still

be able to do the required job. These rejected, but usable, units not only constitute a waste, but necessarily raise the cost of those accepted. The ideal specification, from the producer's point of view, is one which all usable items can meet. The consumer incurs a more obvious risk whenever the specifications that govern acceptance of a product do not encompass all the demands of use. Products accepted as passing the specifications will later fail when exposed to the actual stresses of use, and again - loss. From the consumer's viewpoint, the ideal specification is one which non-usable items cannot meet.

It follows that design, procuring or accepting equipment with specifications that are non-quantifiable or that are not sharply defined has more elements of a guessing game than of a best value procurement.

Scope. The specification value review task is intended to cover the review of decisions associated with the selection, generation and modification of specifications prior to approval, release and use. The reviews should cover the specified requirements in terms of their absolute quantities, tolerances and the selection of other specifications as applicable documents incorporated by reference in whole or in part. Detail Specifications are especially suitable subjects for value review. Product Specifications and Equipment Specifications are the kinds of Commodity Specifications that are appropriate for review of requirements. Materials Specifications and Process Specifications generally are reviewed for their use as applicable documents.

Task Description. The specifications value review task is to perform a timely analysis of the associated specifications in order to identify and to initiate remedy of those elements not consistent with good value. A specification and each element or requirement it contains may be broadly classed as one of the following:

a) An Essential Characteristic - a characteristic which represents the minimum operational, maintenance and reliability needs of the user which must be fulfilled.

b) A Desirable Characteristic - a characteristic which is not essential but which will improve the performance, reliability or maintainability without excessive cost or complexity.

c) An Undesirable Characteristic - a characteristic which is not essential and which will result in unduly high cost or complexity, or will degrade essential characteristics. (Some of these may be apparent only after the complexity of the design and the costs involved are established.)

Application. Specification Value Reviews may be done on any project or program that is characterized by specifications which control any stage in its acquisition. These reviews may be a separate task or they may be combined with Design Value Reviews.

Timing. Research and development programs are especially suitable for specification review in their earliest phases. Department of Defense agencies have an opportunity for specification review prior to the issuance of requests for proposals, especially those for study and development contracts. The preparation and pricing of proposals for design and feasibility studies (e.g., program definition phase) deal mostly with specifications rather than hardware. Early stages of development programs offer opportunity for specifications and design review combinations.

Techniques. The techniques of analyzing a specification for its value considerations are substantially the same as those for a hardware value engineering study. The specification task is more difficult to perform since the object it pertains to may not be in existence yet. This does not preclude the applicability of the value engineering theory of comparing function, cost and worth; it simply means that a more intensive effort is needed.

A starting point for the application of value engineering principles is to determine the cost consequences, quantitatively if at all possible, of each requirement which is specified and each applicable document which is incorporated. The extent to which requirements are specified has a two part effect upon total cost. The first is the cost effect of the absolute magnitude, e.g., the number of degrees farenheit called out as 800°F as opposed to, say, 700°F. The second is the cost contribution of the allowed tolerance on the absolute magnitude. e.g., ±5°F as opposed to ±25°F. The cost consequences of adherence to the referenced specifications should be determined in a similar manner.

Specification Value Review Check List. A check list may be used to facilitate self-review by the specification generator and formal acceptance by a Specification Value Review Board. This list should indicate compliance

with the determination of cost consequences and functional worth. It may be prepared with appropriate questions listed for each major section of the specification: Scope, Applicable Documents, Requirements, Assurance Provisions, Preparation for Delivery and Notes.

A check list will probably need to be prepared for each particular project or hardware type involved. For example, check lists for specifications dealing with an air filtration cartridge for manned spacecraft would have some significant differences compared to those for a portable flame thrower. However, certain general features may be identified which are common to all reviews of specifications. Each review should assure that the following have been considered:

a) Is the specification essential?

b) Is its resultant cost effect upon the product comparable to the worth of the benefits gained by the specification?

c) Is each specified requirement essential?

d) Is the resultant cost effect of the magnitude of each needed requirement comparable to the worth of the benefit gained?

e) Is the resultant cost effect of the tolerance specified on each requirement comparable to the worth of the benefit gained?

f) Is the resultant cost effect of each referenced or incorporated specification comparable to the worth of the benefits derived? (The referenced specifications that are major cost contributors may also need to be reviewed part by part as above.)

MATERIEL VALUE PROGRAM

This section deals with the organizational entity that procures services or equipment from external sources for a monetary consideration. In industry the usual nomenclature for this group is "Purchasing." This Guide uses the term Materiel to cover the various names used by industry and the DoD. About fifty cents of each prime contract dollar is spent with outside vendors, suppliers and subcontractors. DoD agencies annually disburse large sums for direct purchases of many commodities. An active value engineering effort in the organization that directly "spends" the money is a requisite element of an installation's comprehensive value engineering program.

Organization.

There should be a designated value engineering element in the materiel organization in addition to any other assigned value group elsewhere at the installation. Its level and reporting point can not be specified here. It should report at the level and place where command or management feels it will most economically accomplish its purpose. It should be staffed by one or more full time personnel. It is desirable that these personnel have engineering backgrounds, especially at their present location.

Tasks.

Exact descriptions for a Materiel Value Program cannot be given in this Guide as they will depend to a large measure upon the nature of the parent organization. In general, the tasks will fall into two categories: a) those which deal primarily with outside suppliers (vendors, contractors or subcontractors) and, b) those which interface with in-house personnel. Some typical tasks will be discussed as guidelines for establishing specific implementation procedures.

Supplier Category Tasks.

Value Engineering Familiarization. The task involves the efforts necessary to assure that each current and potential supplier is familiar with the value engineering discipline and the in-house value program. Each supplier's value program status needs to be known and assessed. Positive provisions need to exist for assisting suppliers to develop their internal value engineering capability. These may be accomplished by a combination of the following: a) invitations to attend in-house training, b) formal familiarization sessions for invited suppliers, c) bulletins and newsletters, and d) specific questions on vendor survey forms and procedures.

Administration of Contractor or Subcontractor Value Programs. Major contracts and appropriate subcontracts should be evaluated for the type of coverage needed. Contractor performance should be monitored as the contract proceeds. Value engineering change proposals need to be followed through their submission to final disposition.

Supplier Value Engineering Suggestions. A formal process should be developed to obtain input from suppliers on procured parts and services. This may be accomplished by a Value Check List sent out with each request

for quotation, purchase order or data package given to prospective suppliers. Displays may be prepared of current items on which value suggestions are desired and placed in the lobby that suppliers use.

In-house Category Tasks.

Training. The materiel value engineering personnel serve as the focal point for supplier aspects of in-house training. This includes: a) assistance in selection and contact of vendors to take part in the workshops, b) provisions for obtaining vendor quotations during the workshops, c) supplier data for workshop data packages on outside purchased items, d) recommendation of possible workshop projects from among current purchases, and e) lecture support.

Value Studies. This task is concerned with the performance of in-house value engineering studies. The materiel organization has two general responsibilities: a) serving (or providing personnel to serve) as Task Force members and b) selecting, initiating and performing studies of projects from current or potential outside purchases.

Cost Visibility Support. The materiel function possesses vast quantities of cost data. Unfortunately it is usually in much finer detail than can be effectively used by designers during hardware development and by other action level personnel. A logical task for the materiel value engineering personnel is to condense and distribute these data for use in the overall cost visibility effort. For example, average cost data for various outside purchased fabrication processes could be prepared on a per pound basis with the quantity cost break points and standard tolerances. This would facilitate economic choice during the drawing preparation stage.

PROJECT REQUIREMENTS EVALUATION

The Projects Requirements Evaluation task contains some aspects which are common to other tasks previously discussed. Certain portions of this task are also common parts of the normal routine of daily business. However, its use as a formal, identified task with an assigned responsibility is appropriate at certain points in the acquisition process.

Description

Projects Requirements Evaluation is the task of assuring that all of the specified compliance criteria associated with a contract, procurement

or program are in accord with the principles of best value. Its performance entails: a) identification of planned or existing requirements, b) evaluation of them, c) isolation of excessive and unneeded requirements and, d) the initiation of corrective action. This description is similar to the specification and design review tasks. However, it encompasses all of the obligatory elements of a situation rather than just the specifications or the designs. It also examines these criteria as an entity rather than piecemeal.

Requirements.

Sources. This task is suitable for performance with respect to the requisite elements contained in any or all of the following sources associated with a particular procurement:

a) Request for Proposal.
b) Invitation for Bid.
c) Proposal.
d) Statement of Work.
e) Contract Schedule.
f) Contract General Provisions.
g) Program Plan.
h) Subcontracts.

DoD agencies have the opportunity to evaluate these sources prior to their issuance. Industry attention to this task must come after the fact but would still be considerably prior to the start of any fabrication.

Types. All obligatory elements written or incorporated into the source documents are susceptible to this evaluation. A partial listing of typical types follows:

a) Hardware quantity.
b) Spares selection and quantity.
c) Specifications.
d) Exhibits.
e) Standards.
f) Data and documentation selection quantity and format.
g) Approval points.
h) Test, acceptance, packing and delivery.

Procedure.

The procedure may be defined as a series of four steps: a) identification of requirements, b) isolation of unrealistic requirements, c) analysis, and d) initiation of corrective action.

Identification. This step entails detailed examination of all sources of specified mandatory elements associated with the procurement. A list of

the title of each requirement is prepared and then grouped according to its type as noted above. A very short statement of the nature or quantity that each requirement represents is placed with each item on the list. The analyst must become familiar with each listed element.

Isolation. This step is similar to the selection of value engineering projects. However, the intangible nature of words (which is all that is available for this task) requires attention to their implications. The sorting is done by examining each listed compliance criterion for any possible anomalous situations:

a) Applicability of each requirement to the technology of the procured product (e.g., specifications intended for spacecraft required on ground training simulators, or vice versa)

b) Quality and reliability levels beyond the most probable needs.

c) Environmental requirements not typical of the application (e.g., shipboard shock environment called out for equipment to be used in shipyards).

d) Requirement of identical quantities of all reports of all types.

e) Development of new or specialized items that would seem to have been available from previous DoD or commercial programs.

f) Seemingly incongruous requirements for advanced state of the art processes.

g) Any redundant requirements (those that seem to already have been satisfied, in whole or in part, by another requirement in some other place of the program)

h) High cost requirements (those that are the largest cost contributors).

Analysis. Analysis of the mandatory items suspected of poor value is done by using the value engineering theory of function/cost/worth comparison. Value studies or task forces may be the vehicle to carry the analysis. A report of recommendations is the normal output.

Initiation of Corrective Action. The report which is produced by the analysis step should include the details of corrective action. The corrective action procedure will depend upon the procurement, the time phase at which this task is performed, and who performs it, i.e., the DoD or a contractor. In any event, this task includes the responsibility that proper corrective action is brought to the attention of those with the authority to take action.

## PROGRAM ELEMENTS: SUMMARY

A. Value engineering program elements are identifiable tasks that represent value engineering theory reduced to practice and are performed wholly or partially by value engineering personnel.

B. The base for value programs is value engineering training in varying degrees for all personnel whose decisions affect DoD item cost in order to provide capability for self application of the principles of best value.

C. Value Studies are the investigations of selected projects by a value engineer in accord with the Job Plan to produce reports which recommends a lower cost alternate.

D. A Task Force is an ad hoc group of personnel selected from value engineering, materiel, production, engineering, finance and other areas to perform a value engineering investigation of a specific item.

E. The Cost Target task entails the preparation of end item cost goals and periodic comparison with the predicted fabrication cost during the design and development phase.

F. The Value Review program element is the effort necessary to provide positive procedures for the consideration of value engineering principles during design and specification reviews.

G. The implementation of value engineering with respect to outside purchased parts, suppliers, contractors and the support of in-house needs for outside cost data are the main elements of the Materiel Value Program element of the total value program.

H. Projects Requirements Evaluation is the task of applying the value engineering principles to all obligatory criteria of a procurement as included in the RFP, proposal, statement of work, contracts and referenced documents.

# CHAPTER 4: CONTRACTUAL ASPECTS

The DoD uses contracts as the method of pro uring items and services from industry. . . value engineering efforts are usually obtained by placing one of several approved clauses in these contracts. . . the application of value engineering may affect the contract price. . . or the cost of subsequent procurements. . . implementation of some value engineering results requires contract changes. . . contract modifications may be generated by DoD agency value engineering activities. . . This Chapter provides a basis understanding of contracts. . . their use as Government procurement instruments. . . the types of Government contracts in use. . . and a brief treatment of contract modifications.

# CHAPTER 4

# CONTRACTUAL ASPECTS

## PRINCIPLES OF CONTRACTS

### Contract Definition

In a consideration of some of the prin iples of the law of contracts, a simple and logical point of departure is to offer an easily understood and meaningful definition of the term "contract."

It soon becomes eminently clear that not only is there an abundance of such definitions, but there is an almost limitless choice of approaches to the definition. Legal scholars and writers have been prolific in their output of contract definitions. It appears safe to say that every court of competent jurisdiction in the United States has, at one time or another, addressed itself to the task of defining a contract - some courts, even in declaring a contract action outside its jurisdiction, apparently have been unable to resist the challenge of perfecting the definition of a contract.

It is worthwhile, however, to consider briefly some of these definitions.

> "A contract is a promise or a set of promises for the breach of which the law gives a remedy, or the performance of which the law in some way recognizes as a duty."
>
> (ALI Restatement of Contracts, Sec. 1)

> "An agreement between two or more persons, upon sufficient consideration, to do or not to do a particular thing."
>
> (Karpark Corp. v. Town of Graham, 99F. 2nd 124)

> "A promise, or a set of promises, to which the law attaches legal obligation."
>
> (Shelton Moton Co. v. Higdown, 140 SW 2nd 905 (Tex))

"Where one party, for a sufficient consideration, offers to do or not to do a particular thing, and there must be acceptance by the other party of that offer, and this offer and acceptance must be equally binding upon both parties to the agreement, and must be to do a particular thing."

(Warrington v. Reese, 108 A 33, 7 Boyce 390 (Del))

In review of the above definitions note that some definitions are based upon the word "promise" and some are fundamentally concerned with the word "agreement." Additional, some rely heavily for their meaning upon the words "offer," "acceptance" and "consideration."

It becomes evident at this point, that in order to define the term "contract" it would be necessary to carefully consider and define the key terms appearing in the foregoing definitions. This would include not only the academic issue of the term "promise" versus the term "agreement," but the practical consideration of the requisite elements of a legally valid "offer," "acceptance" and "consideration."

Contract Purpose.

Obviously time will not permit this detailed treatment of these fundamental principles and theories underlying the law of contracts. Perhaps, for the purposes here, the real concern is not the definition of a contract. The function and purpose of a contract appears to provide a more meaningful basis for ultimate consideration of the contractual relationship which exists between the Government and a contractor.

Corpus Juris Secundum[1] affords the following statements, concerning the purpose of a contract:

"Generally speaking, the purpose of a contract is to reduce to writing the conditions on which the minds of the parties have met and to fix their rights and duties with respect thereto. As otherwise stated the purpose of every contract is to bind the parties to performance and to place the risk of performance upon the promisor.

The essential elements of a legal contract are generally enumerated as being: (1) Parties competent to contract. (2) A proper subject matter. (3) A legal consideration. (4) Mutuality of agreement. (5) Mutuality of obligation... The law, not the agreement, determines the essential

[1] C. J. S. Contracts, Sec. 1 - 545, 546

elements of a contract, and it is not every agreement which results in a binding, legally enforceable contract. Where a contract is affected with a public interest legislation may prescribe and limit the terms of such a contract, ....."

While the above observations as to the purpose of a contract may be subject to many of the same weaknesses as the numerous definitions of the term "contract," it has been selected for consideration in this brief explaration of contract fundamentals for the following reasons:

1. The recited general purpose of a contract "to reduce to writing the conditions on which the minds of the parties have met and to fix their rights and duties with respect thereto," is a sufficiently definite statement to form a basis for general understanding of the purpose of a contract.

2. The five generally accepted essential elements of a contract, outlined in the CJS statement, provide areas of consideration which lend themselves to limited consideration of some of the elements which are common to contracts between individuals and to contracts between the Government and individuals, as well as providing a basis for high-lighting some of the differences.

3. The statement that "the law, not private agreement determines the essential elements of a contract" is essential to understand that the difficulty in forming an all encompassing definition of the term "contract" or the absolute and final essential elements of a contract, lies principally in the fact that all such terms or elements are subject to the body of contract law which surrounds each of them and therefore subject to the varying interpretation and vagaries of the courts and the law.

4. The final observation in the quotation from CJS appears to be particularly apropos to consideration of the contractual relationship between the Government and the contractor. Possibly in no other area of contractual relationship can be found contracts which are more affected by the public interest, and certainly no greater body of legislation prescribing and limiting the terms of such contracts can be found.

## GOVERNMENT AND COMMERCIAL CONTRACTS

### Definitions

For ease in explaining some of the common and some of the varying or divergent elements and principles of contract law as applied in contracts between private individuals or concerns as opposed to contract between the Government and private individuals or concerns, the following terms will be used:

a) "commercial contracts" will refer to contracts between private individuals or concerns to which the Government is not a party.

b) "Government contracts" will refer to contracts between the Federal Government and private individuals or concerns.

Common Purpose.

The general purpose of a contract was set forth earlier.

> "Generally speaking, the purpose of a contract is to reduce to writing the conditions on which the minds of the parties have met and to fix their rights and duties with respect thereto. As otherwise stated the purpose of every contract is to bind the parties to performance and place the risk of performance on the promisor."[1]

Within the framework of this stated purpose of a contract, there is little difficulty in recognizing the commonality of purpose in both Government and commercial contracts.

If Builder "A" enters into a written contract with Land Developer "B", or if "A" enters into a contract with the Government, to construct a tract of houses for a sum certain and in accordance with agreed upon specifications, terms and period of performance, there is very little opportunity to distinguish between the purpose which the contract served in formalizing "A's" agreement with "B" or his agreement with the Government. In each instance the contract serves to reduce to writing "conditions on which the minds of the parties had met." Certainly, in each instance, rights and duties have been created under the contract and risk of performance rests with "A" (the promisor).

The similarity between commercial and Government contracts does not abruptly end with this commonness of purpose. Were this the case, social and economic chaos would result.

As a general statement, those elements essential to a valid commercial contract must also be present in a Government contract. The rules of construction or interpretation of a contract instrument are generally the same. The obligation of the promisor (contractor) to perform, and the Government's remedies for failure to perform follow the same general pattern as in the field of commercial contracts.

[1] C. J. S., Ibid

Nearly every statement in the foregoing paragraph, while generally true, is subject to notable exceptions which find their basis in statute, the Constitution or in the very nature and identity of the Government itself.

Different and Varying Elements of Government Contracts.

While consistency in the law, and social considerations, dictate that the fundamental principles of the contractual relationship be perpetuated in Government contracts, this same social justice or public interest makes necessary the recognition and enforcement of significant exceptions to these basic principles.

It would be impossible here, to attempt to treat in detail the sometimes very complex circumstances surrounding the contractual relationship with the Government which may give rise to a variant in the normal disposition of a contract problem, when the standard for "normal" disposition is viewed within the framework of the body of law which governs the commercial contract. It is worthwhile to look at a few of the fundamental principles which most commonly set apart the final result reached under a Government contract in contrast to the result under a commercial relationship.

Sovereign Capacity

Probably the most significant factor which differentiates Government contracts from commercial contracts is the sovereign capacity or sovereign entity of the Government. Despite a statement by the United States Supreme Court in 1875 that,

> "If (the Government comes down from its position of sovereignty, and enters the domain of commerce, it submits itself to the same laws that govern individuals there", [2]

it must be remembered that this sovereignty does exist -- and while it may figuratively "step down" to the domain of commerce; literally, in this present day, its sovereign immunity in a shadow-like fashion steps down with it.

Effect of Legislation on Government Contracts.

A recent case before the Armed Service Board of Contract Appeals (Metrig Corp., ASBCA 8455) serves to illustrate both the effect of legislation and the sovereign capacity of the Government on the contractual relationship of the Government and its contractor.

2. Cooke vs U.S., 91U S. 389

In the Metrig case, the apellant entered into a contract with the Government for construction of a housing project in Puerto Rico. The contract incorporated the provisions of the Davis-Bacon Act, and was therefore subject to the minimum wage rates determined by the Secretary of Labor as the minimum prevailing wage rates in that area. On the date on which the contract was executed a Labor Department order, under the Fair Labor Standards Act, also existed prescribing minimum wages for construction work in Puerto Rico at a rate higher than that determined under the Davis-Bacon Act. The provisions of the Fair Labor Standards Act were not formally incorporated in the contract.

The Board in denying the appellant relief for the higher wages required under the FLSA order, held that the contractor had constructive notice of the higher prevailing wage under the FLSA, and following the holding in Aaron v. Ford, Bacon & Davis, Inc.,[3] ruled that the order under the FLSA overrode and superseded the minimum wage under the Davis-Bacon Act.

The Board further denied the contractor recovery of additional labor costs resulting from an increase in the minimum wage prescribed by Congress under the Fair Labor Standards Amendment of 1961 at a date subsequent to the date of execution of the contract and after a considerable period of the contract term had elapsed. The Board in so ruling, held that this increase of the minimum rate was "an act of the Government in its sovereign rather than its contractual capacity and the Board has no authority to grant relief in such cases." (Emphasis supplied)

It should be immediately noted, however, that not all legislative acts of the Government which may relate to the terms of contract performance, are deemed to be its sovereign acts. It was early established, that legislative or executive action of the Government must be general and for the public good in order to constitute an act within its sovereign capacity.[4]

A further consideration of interest, with regard to the sovereign capacity of the Government, is that by specific contract provision most Gov Government contracts issued through the Department of Defense excuse the contractor from the consequences of delays in contract performance

3. Aaron v. Ford, Davis & Bacon, Inc. (1950) 339 U.S. 497, 94 L Ed. 1017
4. Jones vs. United States, Ct. Cl. 383 (1865)

occasioned by acts of the Government in its sovereign capacity. This is of interest, and importance, since it illustrates the ability of the Government, within certain limitations, to elect by specific contract provisions to be treated in its contractual rather than sovereign capacity.

Estoppel and Apparent Authority. In the field of law applicable to commercial contracts, the rules or doctrines of "estoppel" and "apparent authority" may often be invoked.

Simply stated, this rule provides that if one party to a contract is induced to enter into or perform under a contract in reliance on the representations or actions of the other party giving rise to a reasonable conclusion that the second party was acting with due authority when, in fact, no real authority was present -- the party making such representations is "estopped" from asserting this lack of actual contractual authority as a defense against the party who relied on his apparent authority.

This rule finds no application in Government contracts in situations involving the "actual" versus "apparent" authority of a contracting officer. The authority of a contracting officer, in acting as an agent of Government, is prescribed and limited by statute and implementations thereto. Since all persons are presumed to have constructive if not actual notice of the law, they are further presumed to have actual knowledge of the contracting officer's scope of authority and therefore no basis for reliance on the "apparent" authority of the contracting officer. (See Prestex, Inc. ASBCA 6572 (1961)).

The distinction between the law of estoppel and apparent authority applicable to commercial contracts as opposed to Government contracts is succinctly stated by the U. S. Supreme Court in Whiteside vs. United States:[5]

> "Although a private agent, acting in violation of specific instructions, yet within the scope of his general authority, may bind his principal, the rule as to the effect of the like act of a public agent is otherwise, for the reason that it is better that an individual should occasionally suffer from the mistakes of public officers or agents, than to adopt a rule which, through improper combinations or collusions, might be turned to the detriment and injury of the public."

5. Whiteside vs. United States, 93 U. S. 247

## THE ARMED SERVICE PROCUREMENT REGULATION (ASPR)

Authority.

The effect that certain random statutes have had upon Government contracts in general has been dealt with. The specific interest here lies with those Government contracts which are issued through, and administered by, the Department of Defense. The Armed Service Procurement Regulation, issued by the Secretary of the Department of Defense under the authority[1] of Title 10 United State Code 2202 and Department of Defense 4105.30 dated March 11, 1959 must be regarded as the most important single regulation (or law) relevant to this consideration.

The Court of Claims held in a recent case that:

> "As the Armed Service Procurement Regulations were issued under statutory authority, these regulations, ... had the force and effect of law"[2]

As to whether the holding in the above quoted Christian case extends to all provisions of the ASPR expressed in or containing "mandatory" language is, at this point of a time, a somewhat moot question. The decision does, however, serve to underline the important and far reaching effect of the ASPR on DoD contracts.

Even in narrowing the consideration of Government contracts to the ASPR, it is impossible to cover all of the pertinent provisions important (or vital) to DoD contracts. Almost any given part of the regulation could be made the subject of a study requiring more than the time allotted here.

Since the ultimate objective here is to obtain an understanding of Section I, Part 17 of ASPR which deals with value engineering, and particularly the contractual provisions of ASPR implementing the value engineering effort, consideration will be limited to a brief exploration of the ASPR as it pertains to the types of contracts utilized by the DoD and to the manner of modification or changes to Government contracts. Both of these subjects are believed to be particularly pertinent to the understanding of value engineering and its interface with other contract provisions and incentives.

1. The Armed Service Procurement Act of 1947, 62 Stat 21, 41 U.S.C. Sec 151 et seq was the original authority relied upon for issuance of the Armed Service Procurement Regulation.
2. G. L. Christian & Associates vs. United States (Ct. Cl. 1963) 312 F.2d 418.

Advertised and Negotiated Procurements.

In a general sense it may be said that there are two classes of Government contracts: a) those resulting from an advertised procurement, and b) those resulting from a negotiated procurement. For the sake of clarity these will be characterized as procurement methods rather than as specific contract types which will be discussed later.

Advertised Procurements.

Advertised procurement is the preferred method of awarding contracts since it affords the maximum opportunity for effective price competition. The requirement for procurement by formal advertising is stated in mandatory language in 10 U.S.C. 2304(a). Circumstances permitting procurement by negotiation are stated as exceptions to that requirement.

The requirements for procurement through advertising are set forth in the ASPR in Section II. These requirements are both detailed and strictly construed. Explicit instructions are included in this ASPR section governing, among other things, the following requirements:

a) preparation of invitations for bids,
b) solicitation of bids,
c) submission of bids,
d) opening of bids, and
e) contract award.

Since the provisions of ASPR 2-104.1 limit the type of contract to be awarded under advertised procurement to firm fixed price contracts or fixed price with escalation, this places one major restriction on this type of procurement. Successful procurement action under fixed price contracts requires that the specifications and requirements of the item being procured be firmly fixed and susceptible to uniform interpretation.

A second factor which, in the event of an urgent requirement, may limit the use of this type procurement, is the length of time required to follow the procedural aspects of the procurement.

A third general limitation is posed by the problem of procuring a classified item without violating security requirements during the procurement process.

The three limitations discussed in the preceding paragraphs are by way of general limitations as opposed to the specific exceptions set forth in 10 U.S.C. 2304 authorizing the use of negotiated procurements. They do, however, form the basis or rationale for some of the listed exceptions.

Negotiated Procurements.

As pointed out in the foregoing discussion of advertised procurements, the authority for negotiated procurement exists by exception. As codified in 10 U.S.C. 2304, there are seventeen (17) permissible exceptions. While the list of exceptions is somewhat lengthy, they are believed to be of sufficient importance to warrant listing. The code permits negotiation of contracts if:

(1) it is determined that such action is necessary in the public interest during a national emergency declared by Congress or the President;

(2) the public exigency will not permit the delay incident to advertising;

(3) the aggregate amount involved is not more than $2, 500;

(4) the purchase or contract is for personal or professional services;

(5) the purchase or contract is for any service by a university, college, or other educational institution;

(6) the purchase or contract is for property or services to be procured and used outside the United States, and the Territories, Commonwealth, and possessions;

(7) the purchase or contract is for medicine or medical supplies;

(8) the purchase or contract is for property for authorized resale;

(9) the purchase or contract is for perishable or nonperishable subsistence supplies;

(10) the purchase or contract is for property or services for which it is impracticable to obtain competition;

(11) the purchase or contract is for property or services that he determines to be for experimental, developmental, or research work, or for making or furnishing property for experiment, test, development, or research;

(12) the purchase or contract is for property or services whose procurement he determines should not be publicly disclosed because of their character, ingredients, or components;

(13) the purchase or contract is for equipment that he determines to be technical equipment whose standardization and the interchangeability of whose parts are necessary in the public interest and whose procurement by negotiation is necessary to assure that standardization and interchangeability;

(14) the purchase or contract is for technical or special property that he determines to require a substantial initial investment or an extended period of preparation for manufacture, and for which he determines that formal advertising and competitive bidding might require duplication of investment or preparation already made or would unduly delay the procurement of that property; or

(15) the purchase or contract is for property or services for which he determines that the bid prices received after formal advertising are unreasonable as to all or part of the requirements, or were not independently reached in open competition, and for which (A) he has notified each responsible bidder of intention to negotiate and given him reasonable opportunity to negotiate; (B) the negotiated price is lower than the lowest rejected bid of any responsible bidder, as determined by the head of the agency; and (C) the negotiated price is the lowest negotiated price offered by any responsible supplier;

(16) he determines that (A) it is in the interest of national defense to have a plant, mine, or other facility, or a producer, manufacturer, or other supplier, available for furnishing property or services in case of a national emergy; or (B) the interest of industrial mobilization in case of such an emergency, or the interest of national defense in maintaining active engineering, research, and development, would otherwise be subserved; or

(17) negotiation of the purchase or contract is otherwise authorized by law.

In the negotiated procurement process, the procurement requirements are less rigid than under formal advertising and the discretionary powers of the contracting officer are increased. As an example, proposals submitted by the contractor may be opened immediately upon receipt and late proposals or amendments may be considered if it appears to be in the best interest of the Government. Either of these actions could void an entire procurement effort under the advertised procurement concept.

Section III of ASPR treats in detail the conduct of procurement by negotiation. Included in this Section III are instructions on the type of contract to be employed in negotiated procurements.

## GOVERNMENT CONTRACT TYPES

The term "contract type" as employed in the following discussion is used in the context of the type of compensation arrangement between the Government and the contractor as opposed to the form and structure or end purpose of a contract.

In March 1962, Section III, Part 4 of the ASPR which sets forth the types of contracts to be used and recommendations on the use of specific types of contracts, was revised to place emphasis on motivating the defense contractor to a greater assumption of risk through the recognition of a greater profit potential. This has entailed a shift from cost plus fixed fee contracts to firm fixed price or to fixed price and cost reimbursement type contracts with contractor incentive provisions added. While the concept of incentive contracts certainly was not originated by this revision to the ASPR, the emphasis on reduction of procurement costs through the "harnessing of the profit motive" was indeed an innovation.

Following the same arrangement that appears in the ASPR provisions dealing with contract types, the fixed price type contracts and cost reimbursement contracts will be discussed in turn.

### Fixed Price Contracts.

As pointed out in ASPR 3-404.1 there are several types of fixed price contracts, "...so designed as to facilitate proper pricing under varying circumstances." This flexibility is desirable to allow maximum use of the fixed price concept in as many procurement situations as possible which can result in an equitable contractual relationship to both the Government and the contractor.

The Firm Fixed Price Contract - (ASPR 3-404.2). The firm fixed price contract is the most preferred type of contract. Under this type of contract the maximum risk is placed on the contractor, and at the same time, the maximum profit potential exists since the contract price is not subject to either upward or downward adjustment solely by reason of cost experience of the contractor.

The criteria for appropriate use of the firm fixed price contract is set forth in ASPR 3-404.2(b) as follows:

"(b) Application. The firm fixed-price contract is suitable for use in procurements when reasonably definite design or performance specifications are available and whenever fair and reasonable prices can be established at the outset, such as where:

(i) adequate competition has made initial proposals effective;

(ii) prior purchases of the same or similar supplies or services under competitive conditions or supported by valid cost or pricing data provide reasonable price comparisons;

(iii) cost or pricing information is available permitting the development of realistic estimates of the probable costs of performance;

(iv) the uncertainties involved in contract performance can be identified and reasonable estimates of their possible impact on costs made, and the contractor is willing to accept a firm fixed price at a level which represents assumption of a reasonable proportion of the risks involved; or

(v) any other reasonable basis for pricing can be used consistent with the purpose of this type of contract.

The firm fixed price contract is particularly suitable in the purchase of standard or modified commercial items, or military items for which sound prices can be developed."

Fixed Price Contract With Escalation (ASPR 3-404.3). The fixed price contract with escalation differs from the firm fixed price contract by providing for an upward or downward adjustment of contract price upon the occurrence of certain agreed upon contingencies which may affect cost of performance. A ceiling price, limiting the dollar amount of upward adjustment, is contained in this type of contract.

The "price elements" of a contract price generally regarded as being subject to the escalation provision as set forth in ASPR are:

"(1) Price escalation provides for adjustment of the contract price on the basis of increases or decreases from an agreed upon level in published or established prices of specific items or in price levels of the contract end items.

(2) Labor and material escalation provides for adjustment of the contract price on the basis of increases or decreases from agreed standards or indices in wage rates, specific material costs, or both.

The use of this type of contract, in most instances, is limited to a situation involving: a) a long term of contract performance, or b) unstable market or labor conditions. Additionally, escalation is not applicable to contingencies within the control of the contractor.

Fixed Price Incentive Contracts - ASPR 3-404.4. Fixed price incentive type contracts provide for upward or downward adjustment of the contract price by a formula based on the relationship of negotiated final costs to target costs. In addition to this price adjustment based on contractor costs, it is a prevalent practice to include incentive provisions based on performance or delivery in this type of contract.

The ASPR provides for two different approaches to fixed price incentive contracts - contracts employing firm targets and contracts employing successive targets. The description of these approaches is quoted below from ASPR 3-404.4(a)(2) & (3):

> "(2) Firm Target. Under this type of incentive contract there is negotiated at the outset a target cost, a target profit, a price ceiling (but not a profit ceiling or floor), and a formula for establishing final profit and price. After performance of the contract, the final cost is negotiated and the final contract price is then established in accordance with the formula. Where the final cost is less than target cost, application of the formula results in a final profit greater than the target profit; conversely, where final cost is more than target cost, application of the formula results in a final profit less than the target profit, or even a net loss. Thus, within the price ceiling, the formula provides for the Government and the contractor to share the responsibility for costs greater or less than those originally estimated, as determined by a comparison of negotiated final cost with target cost. Because the profit resulting from application of the formula is in inverse relationship to costs, the formula provides the contractor in advance with a calculable profit incentive to control costs. To provide an incentive consistent with the circumstances, the formula should reflect the relative risks involved in contract performance. Thus, it is appropriate in certain procurements to establish a formula which provides for contractor assumption of a considerable or major share of total cost responsibility. In such circumstances, when a major share of total cost responsibility is assumed by the contractor, every consideration will be given to establishing target profits which reflect assumption of such responsibility.
>
> (3) Successive Targets. Under this type of incentive contract, there is negotiated at the outset an initial target cost, an initial target profit, a price ceiling, a formula for fixing the firm target profit, and a production point at which the formula will be applied. Generally, the production point will be prior to delivery or shop completion of the first item. This formula does not apply for the life of the contract but simply is used to fix the firm target profit for the contract. The initial formula shall also provide for a ceiling and floor on the firm target profit. To provide an incentive consistent

with the circumstances, the formula for fixing the firm target profit should reflect the relative risk involved in establishing an incentive arrangement where cost and pricing information were not sufficient to permit the negotiation of firm targets at the outset. Thus it normally will not provide for as great a degree of contractor cost responsibility as would a formula for establishing final profit and price. When the production point for applying the formula is reached, the firm target cost is then negotiated, consideration being given to experienced cost and all other pertinent factors, and the firm target profit is automatically determined in accordance with the formula. At this point, two alternatives are possible. First, a firm fixed price may be negotiated using as a guide the firm target cost plus the firm target profit. Second, if use of the firm fixed price is determined to be inappropriate, a formula for establishing final profit and price may be negotiated, using the firm target profit and the firm target cost. As in the firm target type of contract described in (a)(2), the final cost is negotiated at the completion of the contract and the final contract price is then established in accordance with the formula for establishing final profit and price.

Prospective Price Redetermination (ASPR 3-404.5). This type of contract provides for a firm fixed price contract for an initial phase of the contract with upward or downward price adjustment at an agreed upon time (or times) for succeeding phases or periods of the contract. Use of this type contract is generally limited to procurements involving delivery of a substantial quantity of items over an extended period of time where the initial period contract effort is susceptible to establishment of fair and reasonable firm prices but the circumstances of the procurement do not afford the required visibility to establish a firm price for the total contract period.

Retroactive Price Redetermination (ASPR 3-404.7). This is the least desirable of all fixed price contract types. This type of contract provides for the determination of final contract price after completion of work. Since the only control over the contractor exists by reason of a contract ceiling, this type of contract affords little incentive for effective cost control by the contractor. This type of contract is suitable for use only when the procurement is very small or of short time duration and not susceptible to negotiation of a fair and reasonable firm fixed price at the outset.

Cost Reimbursement and Contracts.

Cost reimbursement contracts differ from fixed price contracts in that a contractor may, in accordance with contract provisions, be reimbursed

for allowable costs in excess of those costs originally estimated for contract performance. Risk to the contractor is minimized since he is generally under no obligation to continue with contract performance after such time as total estimated cost of the contract has been expended.

Cost reimbursement type contracts are not to be used except when: a) it is likely that it will be less costly to the Government, or b) when it is impractical, due to the nature of the supplies or services being procured to utilize other contract types.

Cost Contract - (ASPR 3-405.2). Under a cost contract, the contractor is reimbursed allowable cost of performance but receives no fee. Facilities contracts are good examples of this type contract.

Cost-Sharing Contract (ASPR 3-405.3). In this type of contract, the contractor receives no fee and is reimbursed for only an agreed upon portion of allowable costs. This type is generally used for research and development contract with non-profit or educational institutions.

Cost-Plus-Fixed-Fee (ASPR 3-405.5). The cost-plus-fixed-fee type contract is the least desirable type contract since it affords little or no incentive to the contractor for effective cost control. Under this type contract, the contractor is reimbursed his allowable cost and a fixed fee. After the fee is established it is not affected by actual costs and may be adjusted only as a result of subsequent changes in the work or services supplied under the contract.

This type of contract is limited to use in situations requiring a cost reimbursement type contract calling for research or exploratory effort with a level of effort which cannot be predicted with any reasonable degree of accuracy and which is not susceptible to special incentive features.

Cost-plus-fixed-fee contracts are subject to a statutory fee limitation of 15 percent of estimated cost at the time of entering into the contract in the case of contracts for research, development or experimentation, 10 percent for other type efforts except for architectural and engineering contracts which are limited to a 6 percent fee.

Cost-Plus-Incentive-Fee (ASPR 3-405.4) The cost-plus-incentive-fee contract provides for the initial negotiation of a target cost, target fee and a minimum and maximum fee together with a fee adjustment formula. The

formula for adjustment of fee is based upon total allowable costs incurred in relation to the target cost and may also include performance and delivery goals which operate to increase or reduce the fee in accordance with the contractor's performance in achieving these goals. The formula provides, within limits, for increase in fee if the total final allowable cost is under the target cost and for a decrease in fee when total cost exceeds the target. Likewise, the formula provides for increase or decrease in target fee depending on the contractor's performance in meeting or failing to meet the incentive performance or delivery goals, if such incentives are included. In order to achieve meaningful results under the cost incentives it is recommended that the formula be effective over variations in costs of at least 25 percent from target.

Under this type of contract the contractor may attain a maximum fee up to the statutory limit, (ASPR 3-405.4(c) provides that the statutory limitations are applicable to CPIF contract) or his fee may be reduced to zero or even to a "negative" fee.

## CONTRACT MODIFICATIONS

Since the incorporation of a value engineering change proposal into the contract may be accomplished through the use of the "Changes" clause or article of the contract, it is meaningful to explore briefly the subject of modification of Government contracts. It is generally stated that there are three methods of modifying Government contracts, a) by changes, b) by supplemental agreement, and c) by extras.

Of the three methods mentioned it is believed that the first two, i.e., contract changes and supplemental agreements are the most pertinent consideration here. Time alone, if nothing else, supports this belief since the exploration of the area of "extras" would require a detailed study of the case law on the subject. Extras are suspended in a contractual limbo somewhere between a supplemental agreement and a change.

### Changes.

The authority for a contract change stems from the contract instrument itself. The ASPR provides for "Changes" clauses which are to be included in the various types of fixed price and cost reimbursement contracts.

The following "Changes" clause appears at ASPR 7-203.2 and is prescribed for use in cost reimbursement supply contracts:

> "The Contracting Officer may at any time, by a written order, and without notice to the sureties, if any, make changes, within the general scope of this contract, in any one or more of the following: (i) drawings, designs, or specifications, where the supplies to be furnished are to be specially manufactured for the Government in accordance therewith; (ii) method of shipment or packing; (iii) place of delivery; and (iv) the amount of Government-furnished property. If any such changes causes an increase or decrease in the estimated cost of, or the time required for the performance of any part of the work under this contract, whether changed or not changed by any such order, or otherwise affects any other provision of this contract, an equitable adjustment shall be made (i) in the estimated cost or delivery schedule, or both, (ii) in the amount of any fixed fee to be paid to the Contractor, and (iii) in such other provisions of the contract as may be so affected, and the contract shall be modified in writing accordingly. Any claim by the Contractor for adjustment under this clause must be asserted within thirty (30) days from the date of receipt by the Contractor of the notification of change; provided, however, that the Contracting Officer, if he decides that the facts justify such action, may receive and act upon any such claim asserted at any time prior to final payment under this contract. Failure to agree to any adjustment shall be a dispute concerning a question of fact within the meaning of the clause of this contract entitled "Disputes." However, nothing in this clause shall excuse the Contractor from proceeding with the contract as changed."

While the "Changes" clause varies to some extent in the different types of fixed price and cost reimbursement contracts, the above clause is generally representative of all such clauses. The overall rights and obligations of the parties under the clause remains basically the same in all types of contracts.

The principal provisions of the clause are:

a) The contracting officer can make changes, within the general scope of the contract, to designated areas of the existing contract agreement.

b) An equitable adjustment to cost, fee and delivery schedule to the extent that each of these elements are affected by the change.

c) The contractor must make a timely claim for any adjustment.

d) The contractor must continue with the contract work as changed pending resolution of any dispute which might arise over the terms of the contract adjustment.

Since the Government is the contracting party with the right of initiating the change to the contract and since the contractor is obligated to proceed with the work as changed, modification to the contract accomplished through the use of the "Changes" clause is described as a unilateral right which vests in the Government by provisions of the contract.

Supplemental Agreements.

In the preceding paragraph it was pointed out that the right of a contract change was unilateral because the right to accomplish the change was vested in only one of the parties to the contract. On the other hand, a supplemental agreement is bilateral in nature. It requires the formal assent of both parties to the contract. A supplemental agreement, in actuality, is a new agreement by the parties affecting their rights and obligations under the contract.

The distinction between a contract change and a supplemental agreement can possibly best be drawn by looking, again for a moment, at the contract change provision. If a change initiated by the Government has no effect on cost, fee or schedule under the contract, the change is fully accomplished by the unilateral action of the Government in issuing the change. If an adjustment to cost, fee or delivery schedule is required by the change, this new agreement of the parties can be expressed only by the bilateral action of a new supplemental agreement.

In the discussion of the operation of value engineering contract provisions on the following pages it will be noted that the "Changes" article of the contract may, and supplemental agreements will, be utilized to implement the value engineering cost reductions.

## CONTRACTUAL ASPECTS: SUMMARY

A. The purpose of a contract is generally to reduce to writing the conditions, rights and duties which the parties have agreed will bind them and which place the risk of performance on the promisor.

B. Contracts which the Government is a party to are subject to different elements of law and regulations than commercial contracts.

C. The Armed Services Procurement Regulation is a fundamental source of uniform direction for DoD contracts.

D. All DoD contracts must be awarded by the Advertised Procurement process unless one of 17 exceptions prevails which allow the use of the Negotiated Procurement process.

E. The Advertised Procurement process requires submission of competitive bids on items with sufficiently definitive specifications to permit the use of firm fixed price or fixed price with escalation type contracts.

F. The Negotiated Procurement process allows the submission of proposals rather bids or offers which are the basis for discussions between one or more contractors and the Government for final agreement on the contract type, form and tasks.

G. Fixed price contract procurements are characterized by definitive specifications, high contractor financial risk, payment upon delivery and higher profit than cost reimbursement contracts.

H. Cost reimbursement contract procurements are characterized by areas of uncertainty in the specifications, low contractor risk, payment for progress towards delivery and lower profit than fixed price contracts.

I. The changes clause in Government contracts allows the contracting officer to make changes "within the general scope" of the contract which the contractor must comply with while making timely claim for resultant increases in contract cost.

# CHAPTER 5: ASPR PROVISIONS FOR VALUE ENGINEERING

The Armed Services Procurement Regulation provides policy and clause language for incorporating value engineering in Government contracts... Part 17, "Value Engineering," of Section I of ASPR is introduced paragraph by paragraph... comments are made on significant portions... the types of value engineering clauses.. their application... cost reduction proposal submittal... and contract price adjustment computation are given in detail... Nine case problems are offered on various contractual aspects of value engineering... a Value Engineering Contract negotiation Workshop is described... and a case problem suitable for team exercise is presented.

# CHAPTER 5

## ASPR PROVISIONS FOR VALUE ENGINEERING

The Armed Services Procurement Regulation first incorporated value engineering provisions by ASPR Revision 45 (1955 Edition) dated 20 April 1959. Command approval was required for the incentive provisions to be used in contracts. ASPR Revision 8, 15 March 1962, established permissive provisions which could either require or encourage contractors to perform value engineering studies. ASPR Revision 13 (1960 edition), 31 December 1962, added a new Part 17 to Section 1 of the ASPR entitled, "Value Engineering." It established requirements for the inclusion of value engineering clauses in defense contracts. This Section was revised in November 1963 by ASPR Revision 3, which is the current ASPR on value engineering. An understanding of this Section is necessary to choose the proper clause for each procurement, to negotiate the contract and to evaluate its results. Contractors are not bound by the ASPR on value engineering, but by what is in their contract.

### ASPR SECTION I, PART 17 - VALUE ENGINEERING

The regulations pertaining to value engineering are set forth in the Armed Services Procurement Regulation at Section I Part 17 (ASPR 1-1700). The section begins with a brief statement of the purpose of value engineering.

> 1-1701 Policy.
> (a) General. Value engineering is concerned with elimination or modification of anything that contributes to the cost of an item but is not necessary to required performance, quality, maintainability, reliability, standardization or interchangeability.

The paragraph then continues with a definition that is at first specific and then broad.

> Value engineering usually involves an organized effort directed at analyzing the function of an item with the purpose of achieving the required function at the lowest overall cost. As used in this Part, "value engineering" means a cost reduction effort not required by any other provision of the contract. It is the policy of the Department of Defense to incorporate provisions which encourage or require value engineering in all contracts of sufficient size and duration to offer reasonable likelihood for cost reduction. Normally, however, this likelihood will not be present in contracts for construction, research, or exploratory development.

Revision 3 to ASPR (November 15, 1963) deleted the previous value engineering requirement without incentives, leaving the present two types of contract clauses.

> Value engineering contract provisions are of two kinds:
>
> (i) value engineering incentives which provide for the contractor to share in cost reductions that ensue from change proposals he submits; and
>
> (ii) value engineering program requirements which obligate the contractor to maintain value engineering efforts in accordance with an agreed program, and provide for limited contractor sharing in cost reductions ensuing from change proposals he submits.

The cost comparison of an existing contract requirement with a proposed revision to the contract requirement can be valid only if the two requirements are assumed to be chronologically compatible. In other words, a delay in accepting a cost reduction proposal can reduce or even eliminate the estimated cost reduction. It was for this reason that Revision 3 to ASPR added the following statement on the processing of value engineering change proposals.

> (b) Processing Value Engineering Change Proposals. In order to realize the cost reduction potential of value engineering, it is imperative that value engineering change proposals be processed as expeditiously as possible.

Thus far we have mentioned the purpose of value engineering and the types of contract clauses. We now come to the reason why these contract clauses were developed. The description of a value engineering incentive clearly limits its applicability to: a) contractor generated cost reduction

proposals, b) submitted to the Government, c) which require a formal contractual change, and d) which are accepted by the Government.

1-1702 Value Engineering Incentives.

1-1702.1 Description. Many types of contracts, when properly used, provide the contractor with an incentive to control and reduce costs while performing in accordance with specifications and other contract requirements. However, the practice of reducing the contract price (or fee, in the case of cost-reimbursement type contract), under the "Changes" clause tends to discourage contractors from submitting cost reduction proposals requiring a change to the specifications or other contract requirements even though such proposals could be beneficial to the Government. Therefore, the objective of a value engineering incentive provision is to encourage the contractor to develop and submit to the Government cost reduction proposals which involve changes in the contract specifications, purchase description or statement of work. Such changes may include the elimination or modification of any requirements found to be in excess of actual needs regarding, for example, design, components, materials, material processes, tolerances, packaging requirements, or testing procedures and requirements. If the Government accepts a cost reduction proposal through issuance of a change order, the value engineering incentive provision provides for the Government and the contractor to share the resulting cost reduction in the proportion stipulated in the value engineering incentive provision.

The next section outlines the contracts which are required to contain a value engineering incentive contract provision. Note that if value engineering clause coverage is not provided where required, the Head of the Procuring Activity must concur that no potential existed for cost reduction.

1-1702.2 Application.

(a) Except as limited by paragraph 1-1702.3 below, a value engineering incentive provision shall be included in all advertised and negotiated procurements in excess of $100,000 unless (i) a value engineering program requirement is included in the contract in accordance with 1-1703.2, or (ii) the Head of the Procuring Activity has determined that value engineering offers no potential for cost reduction, as, for example, where a particular contract or class of contracts is of insufficient duration to allow value engineering proposals to be processed, or where the item or class of items being procured is a commercial product whose design and cost are controlled by the commercial market. Value engineering incentive provisions also may be included in contracts of less than $100,000 at the discretion of the contracting officer.

Note that the word "shall" is used to describe the application of the value engineering incentive provisions. The exceptions to this requirement are (1) contracts under $100,000, (2) contracts which contain the program requirement clause and (3) contracts which the Head of the Procuring Activity determines do not offer a potential for cost reduction, or (4) contracts excepted by section 1-1702.3 below.

Paragraph (b) is a forward reference to the contract clauses.

Paragraph (c) sets forth certain "guideline" parameters for establishing value engineering share-lines when the value engineering incentive contract clause is utilized.

> (b) Contract clauses providing value engineering incentives are set forth in 1-1705.
>
> (c) The precise extent to which the contractor should share in cost reduction must be tailored to the particular procurement. For advertised contracts, the percentage of contractor sharing shall be stated in the "Value Engineering Incentive" clause in the invitation for bids. For negotiated contracts, the percentage of contractor sharing shall be stated in the solicitation, although this percentage may be a subject of negotiation prior to award. In two-step formal advertising, although discussion of the appropriate percentage of contractor sharing is permissible in connection with the first step, a single percentage shall be stipulated in the invitation for bids that is issued at the beginning of the second step. In the case of firm fixed-price contracts, fixed-price contracts providing for escalation, and fixed-price contracts providing for prospective redetermination, the contractor's share in any cost reduction normally should be 50%, and in no event greater than 75%. However, if such contracts are not awarded on the basis of adequate price competition, a contractor's share of less than 50% may be appropriate. In the case of an incentive type contract, if it is determined that reasonable certainty exists that cost savings can be accurately estimated, the contractor's share may be up to 50%; if such a certainty does not exist, his share should be in accordance with the maximum over-all cost incentive pattern of the contract.

Note that firm fixed price contracts will ordinarily have a contractor share line of between 50 and 75 percent and incentive type contracts with the value engineering incentive contract clause may have a contractor share line of up to 50 percent. The contractor's share in value engineering incentive provisions is significantly larger than the contractor's share of savings generated within the cost incentive provisions of incentive contracts

This larger share of value engineering change proposals reflects a proportionately larger financial risk which will be apparent later.

Paragraph (d) raises the problem of the situation where a value engineering change proposal would distort contract performance incentives if they are also present in the contract. This paragraph provides for the situation that would arise if an accepted value engineering cost reduction proposal changed the hardware parameters which were the bases for the performance incentive provisions.

> (d) When a value engineering incentive is to be included in a contract that will also include performance incentives that might be affected by changed specifications resulting from value engineering, the contract should include an appropriate provision to permit equitable revisions to the performance incentive provisions in the event that a cost-reduction proposal is adopted which affects the basis for computing the performance incentive so substantially that the performance incentive provisions would be rendered fundamentally unreasonable, or entirely beyond that contemplated by the parties at the time the contract was entered into.

Paragraph (e) covers the allowability of value engineering costs. It is interpreted in detail in the section on Funding in the next chapter. In summary, it allows as overhead the value engineering costs on contracts with value engineering incentive clauses.

> (e) Since the value engineering incentive clause does not require the contractor to perform value engineering, it is intended that the inclusion of the value engineering incentive clause in itself will not increase costs to the Government beyond those considered reasonable for the conduct of the contractor's business or the performance of the contract. Where cost analysis is required, cost allowability will be determined in accordance with normal application of the principles and the procedures provided in Section XV. Accordingly, where a contractor already has a value engineering program, the Government will bear a reasonable and allocable share of the cost of this program, but inordinate value engineering cost increases incurred solely because of inclusion of the clause shall not be allowed. Similarly, where a contractor does not have a value engineering program in existence, proper allocable costs of instituting a reasonable value engineering program are allowable.

Section 1-1702.3 should be read in relation to Section 1-1702.2(a) above.

1-1702.3 Limitations. Normally, value engineering incentive provisions shall not be included in procurements for construction, research, or exploratory development. In addition, with the exception of cost-plus-incentive fee contracts, value engineering incentive provisions shall not be included in cost-reimbursement type contracts; however, a value engineering program requirement shall be included if otherwise appropriate (see 1-1703.2).

The second type of contract clause, the "Value Engineering Program Requirement" clause is now defined.

1-1703 Value Engineering Program Requirements.

1-1703.1 Description. A value engineering program requirement is a contract provision that obligates the contractor to engage in a program requiring a specified level of value engineering effort. It differs from a value engineering incentive in that the scope and level of effort required by the Government are specifically stated as an item of work in the contract schedule. It also differs in that benefits are expected to result not only from the development of specific cost reduction change proposals, but from a continuous value engineering effort by the contractor in all or selected phases of contract performance and from the submission to the Government of reports reflecting the results of such effort. The principal goal of a value engineering program requirement is to realize the potentialities of value engineering, insofar as practicable, at a time when it will do the most good i.e., in the initial stages of the design-development-production cycle, so that specifications, production drawings and methods will reflect the full benefit of value engineering as early as possible. The particular value engineering program to be required should be tailored to the particular contract situation with a view toward this goal, and shall be set forth in the contract schedule as a line item. The "Value Engineering Program Requirement" clause provides for contractor sharing in savings ensuing from the adoption of resulting change proposals.

Note that any time a contract contains a value engineering program requirement, the contract schedule should specifically spell out the level of effort. The program requirement is a statement of work item of the contract and should be treated as such. Contrary to a somewhat popular opinion on value engineering, the useful application of value engineering is not confined to large multi-unit production contracts. Quite to the contrary, ASPR states that the most valuable use of value engineering is during the initial stages of the design and development of a particular item. Once that item is developed to a particular design, drawings, tooling, processes, test procedures, test equipment, etc., are all set up for the

production run. To effect even a small change in the unit at this point could involve enormous implementation costs. Note that the program requirement clause allows contractor sharing of savings identical to those described by the "Value Engineering Incentive" clause.

Section 1-1703.2 prescribes the type of contract situation where the "Value Engineering Program Requirement" clause is to be utilized.

> 1-1703.2 Application.
>
> (a) Except as limited by 1-1703.3 below, a value engineering program requirement shall be included in each cost-plus-fixed-fee contract in excess of $1,000,000, unless the Head of the Procuring Activity has determined that the potential for cost reduction does not justify the effort involved in the establishment of a special value engineering program. In addition, a value engineering program requirement may be included in cost-plus-incentive fee contracts in excess of $1,000,000, if the contracting officer determines that the lack of a firm specification, precise purchase description or detailed statement of work would be likely to render a value engineering incentive provision incapable of realizing the contract's potential for value engineering cost reduction. Under these same conditions, a value engineering program requirement may also be substituted for a value engineering incentive provision in a fixed-price type contract if approved by the Head of the Procuring Activity or his designee. If a value engineering program requirement is otherwise applicable, it may be included in contracts of less than $1,000,000.

Now turn back to Section 1-1702.2 and examine the interface of the requirement for the value engineering incentive clause with the requirement for the value engineering program clause. Also note the language regarding the application of the program requirement to cost plus incentive fee (CPIF) type contracts -- "if the contracting officer determines that for various reasons a value engineering incentive clause will not maximize the contract's potential for value engineering."

Continuing on, paragraph (b) is a forward reference to the contract clauses

Paragraph (c) sets forth certain guideline parameters for establishing share lines when the "Value Engineering Program Requirement" clauses are utilized

> (b) Contract clauses providing for a value engineering program are set forth in 1-1706

(c) When a value engineering program requirement is included, the precise extent to which the contractor should share in cost reductions ensuing from the adoption of any acceptable change proposal must be tailored to the particular procurement situation. The percentage of contractor sharing shall be stated in the solicitation, although this percentage may be a subject of negotiation prior to award. In the case of firm fixed-price contracts, fixed-price contracts providing for escalation, and fixed-price contracts providing for prospective redetermination, the contractor's share shall in no event be greater than 25%. In the case of an incentive-type contract, if it is determined that reasonable certainty exists that cost savings can be accurately estimated, the contractor's share may be up to 25%; if such a certainty does not exist, his share should be in accordance with the maximum over-all cost incentive pattern of the contract. In the case of cost-plus-fixed fee contracts, the contractor's share of the savings shall normally be 10% and shall not exceed this figure.

At this point it would be useful to compare the recommended share lines for contracts containing the program requirement clause with the share lines recommended in Section 1-1702.2(c) for use in contracts containing the incentive clause. The program requirement clause provides for a considerably smaller contractor share. This reflects the lower contractor financial risk attendant upon the finding of the program requirements clause.

Paragraph (d) raises the problem of the situation where a value engineering change proposal could distort the contract performance incentives, similar to that previously discussed for the "Value Engineering Incentive" clause.

Paragraph (e) covers the allowability of value engineering costs. This paragraph will be interpreted in the section on funding in Chapter 6. In summary, the costs associated specifically with a value engineering program requirement may be direct when these are allowable under Section XV of the ASPR.

(e) Except to the extent that the price or estimated cost of a contract includes an amount specifically to cover a required value engineering program, the inclusion of a value engineering program requirement should not in itself increase costs to the Government beyond those considered reasonable for the conduct of the contractor's business or the performance of the contract. Where cost analysis is required, cost allowability will be determined in accordance with normal

application of the principles and procedures provided in Section XV. Accordingly, when a contractor already has his own value engineering program, the Government will also bear a reasonable and allocable share of the cost of such program, to the extent not included in the cost of the value engineering program required by the contract. Inordinate value engineering cost increases in the contractor's own program, incurred solely because of inclusion in the contract of the value engineering program requirement, shall not be allowed. Similarly, where a contractor does not have his own value engineering program in existence, proper allocable costs of instituting a reasonable value engineering program to the extent not included in the program required by the contract, are allowable.

Section 1-1703.3 further defines the contract situations specified in Section 1-1703.2(a) as to when the value engineering program requirement should not be utilized.

1-1703.3 Limitations. Normally, value engineering program requirements shall not be included in procurements for construction, research, or exploratory development. A value engineering program requirement shall not be used in formally advertised contracts, and generally should not be used in negotiated contracts where award will be made solely on the basis of price competition.

Section 1-1704 sets forth the requirement that all contracts containing a value engineering contract clause should also contain a "Data" clause or "Technical Information" clause in the case of overseas contracts.

1-1704 Data and Technical Information. A "Data" clause (see 9-203) shall be included in all contracts containing value engineering provisions, except in the case of overseas contracts, in which case the "Technical Information" clause (see 9-206) shall be included. Where a "Data" clause is included in a contract solely because of a value engineering provision, the following should be inserted immediately after the caption of the clause: "This clause applies only to data submitted to the Government in connection with a cost reduction proposal under the provisions of this contract regarding value engineering."

The particular contract clauses are now given. The first set of clauses are the incentive and the second set is the program requirement clauses.

1-1705 Value Engineering Incentive Clauses. If it is determined, in accordance with 1-1702, to include a value engineering incentive provision in a contract, the applicable clause set forth below shall be used.

1-1705.1 Value Engineering Incentive Clause for Firm Fixed-Price Contracts and Fixed-Price Contracts Providing for Escalation.

VALUE ENGINEERING INCENTIVE (AUG. 1963)

(a) This clause applies to cost reduction proposals initiated and developed by the Contractor for changing the drawings, designs, specifications or other requirements of this contract. This clause does not, however, apply to any such proposal unless it is identified by the Contractor at the time of its submission to the Contracting Officer, as a proposal submitted pursuant to this clause. The cost reduction proposals contemplated are those that:

(i) would result in less costly items than those specified herein without imparing any of their essential functions and characteristics such as service life, reliability, economy of operation, ease of maintenance, and necessary standardized features; and

(ii) would require, in order to be applied to this contract, a change order to this contract.

Paragraph (a) (ii) is a recognition of the fact that, particularly in firm fixed price contracts, there are many cost reduction ideas which can be effected which do not require a contract modification. A purpose of value engineering is to expand the profit motivation to promote cost reduction proposals which do require a contract change. Those changes which do not require a contract change naturally continue to be implemented by the contractor as he sees fit, and he retains 100 percent of any such cost reduction. Value engineering contract clauses apply only to cost reduction proposals which would require, in order to be used, a change order to the contract.

Paragraph (b) of the clause defines the information which should be submitted by the contractor in a value engineering proposal.

(b) Cost reduction proposals as defined herein will be processed expeditiously and in the same manner as prescribed for any other proposal which would likewise necessitate issuance of a contract change order. As a minimum, the following information will be submitted by the Contractor with each proposal:

(i) a description of the difference between the existing contract requirement and the proposed change, and the comparative advantages and disadvantages of each:

(ii) an itemization of the requirements of the contract which must be changed if the proposal is adopted and a recommendation as to how to make each such change (e.g., suggested revision);

(iii) an estimate of the reduction in performance costs that will result from adoption of the proposal taking into account the costs of implementation by the Contractor, and the basis for the estimate;

(iv) a prediction of any effects the proposed change has on other costs to the Government, such as Government-furnished property costs, costs of related items, and costs of maintenance and operation;

(v) a statement of the time by which a change order adopting the proposal must be issued so as to obtain the maximum cost reduction during the remainder of the contract, noting any effect on maintaining the contract delivery schedule; and

(vi) the dates of any previous submissions of the proposal, the numbers of any Government contracts under which submitted, and the previous actions by the Government, if known.

Of particular interest in this paragraph is subparagraph (iv). At the present time the contractor is not entitled to any share in the benefits which may accrue to the Government through lower maintenance costs, follow-on contracts, etc. Secondly, attention is invited to subparagraph (v). The proposal is directed to stipulate a time by which the Government should elect to adopt the proposal in order to obtain the maximum cost reduction. However, as stated in paragraph (c) below, the Government has the right to accept a proposal at any time. The Government also has the right to accept any proposal in whole or in part.

(c) The Government shall not be liable for any delay in acting upon, or for any failure to act upon, any proposal submitted pursuant to this clause. The decision of the Contracting Officer as to the acceptance of any such proposal under this contract shall be final and shall not be subject to the "Disputes" clause of this contract. Unless and until a change order applies such a proposal to this contract, the Contractor shall remain obligated to perform in accordance with its existing terms. The Contracting Officer may accept in whole or in part any cost reduction proposal submitted pursuant to this clause by issuing a change order which will identify the cost reduction proposal on which it is based.

(d) If a cost reduction proposal submitted pursuant to this clause is accepted under this contract, an equitable adjustment in the contract price and in any other affected provisions of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. If the equitable adjustment involves a reduction in the contract price, it shall

be established by determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from the adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor, and reducing the contract price by..... percent (.....%)* of such decrease. If the equitable adjustment involves an increase in the contract price, such increase shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause.

Paragraph (d) is the actual operating section of the clause. In the firm fixed price clause the price is being reduced by a percentage, therefore, the Government's side of the share line should appear in the clause itself.

Secondly, as we discussed before, the Government may make a partial acceptance or make a late acceptance of any proposal. Under these conditions, it is possible that the Government's acceptance of a proposed cost reduction can result in an increase rather than a decrease in the contract costs. It was for this reason that the second to last sentence of paragraph (d) was added to the contract clause by ASPR Revision No. 3.

The operation of this clause will be illustrated in Case Problem No. 1 later in this chapter.

Paragraph (e) permits the contractor to make multiple submissions of a cost reduction proposal on any contracts which he has which can utilize the proposed changes and which contain this provision.

(e) Cost reduction proposals submitted under the provisions of any other contract also may be submitted under this contract for consideration pursuant to the terms of this clause.

Paragraph (f) gives the contractor the right to restrict the Government's use of any data submitted under this clause until such time as the Government accepts the proposal.

(f) The Contractor may restrict the Government's right to use any sheet of a value engineering proposal or of the supporting data, submitted pursuant to this clause, in accordance with the terms of the following legend if it is marked on such sheet:

This data furnished pursuant to the value engineering incentive clause of contract..... shall not be disclosed outside the Government, or be duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate

* Insert the appropriate percentage, i.e., the Contractor's share (see 1-1702.2(c).

a value engineering proposal submitted under said clause. This restriction does not limit the Government's right to use information contained in this data if it is or has been obtained from another source, or is otherwise available, without limitations. If such a proposal is accepted by the Government by issuance of a change order under the "Changes" clause of said contract after the use of this data in such an evaluation, the Government shall have the right to duplicate, use, and disclose any data pertinent to the proposal as accepted, in any manner and for any purpose whatsoever, and have others so do.

After the issuance of a change order accepting a value engineering proposal, but not prior thereto, such proposal and the supporting data shall, for the sole purpose of supplementing the rights granted to the Government under this paragraph, be considered "Subject Data" within the meaning of the "Data" clause of this contract.

For fixed price incentive (FPI) contracts, the "Value Engineering Incentive" clause is modified by substituting the alternate paragraph (d) as set forth in 1-1705.2

1-1705.2 Value Engineering Incentive Clause for Fixed-Price Incentive Contracts (Firm Targets). For fixed-price incentive contracts (firm targets), insert the clause set forth in 1-1705.1 above, modified by the substitution of the following paragraph (d) thereof:

(d) If a cost reduction proposal submitted pursuant to this clause and affecting any of the items described in paragraph (a) of the "Incentive Price Revision (Firm Target)" clause of this contract is accepted under this contract, an equitable adjustment in the total target price of such items and in any other affected provision of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. The equitable adjustment in such total target price shall be established by (i) determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor, and (ii) deducting the full amount of this estimated decrease from the total target cost and adding ..... percent (..... %)* of such amount to the total target profit relating to such items. The maximum dollar limit on the total final price of such items, which is expressed in said paragraph (a) as a percentage of the total target cost thereof, shall be increased by the total amount of any adjustments in the total target profit that have been established pursuant to this clause. If the equitable adjustment involves an increase in the contract price, such increase shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause.

* Insert the appropriate percentage, i.e., the contractor's share (see 1-1702.2(c))

The operation of this clause will be illustrated in Case Problem No. 2 later in this chapter.

For FPI (Successive Targets) contracts, the clause set forth in 1-1705.1 is modified by substituting the alternate paragraph (d) as set forth in 1-1705.3.

> 1-1705.3 Value Engineering Incentive Clause for Fixed-Price Incentive Contracts (Successive Targets). For fixed-price incentive (successive targets) contracts, insert the clause in 1-1705.1 above, modified to substitute the following for paragraph (d) thereof:
>
> (d)(1) If a cost reduction proposal submitted pursuant to this clause and affecting any of the items described in paragraph (a) of the "Incentive Price Revision (Successive Targets)" clause of this contract is accepted under this contract, an equitable adjustment in the total initial or firm target price of such items and in any other affected provision of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. Except as otherwise provided in paragraphs (2) and (3) below the equitable adjustment in such total initial or firm target price shall be established by (i) determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor and (ii) deducting the full amount of this estimated decrease from the initial or firm total target cost of such items (whichever is in effect at the time of adjustment), and adding ..... percent (.....%), * or such other percentage as may be applicable pursuant to paragraph (2) below, of such amount to the initial or firm target profit relating to such items (whichever is in effect at the time of adjustment). Except where a firm fixed-price has been established in accordance with paragraph (c) of said price revision clause, if such a cost reduction proposal is accepted under this contract either before or after the establishment of a firm profit adjustment formula in accordance with said paragraph (c), the maximum dollar limit on the total final price of such items, which is expressed in said paragraph (a) as a percentage of the total initial target cost thereof, shall be increased by the amount of any adjustments in the total initial or firm target profit (whichever is in effect at the time of adjustment), that have been established pursuant to this clause.
>
> (2) If a cost reduction proposal submitted pursuant to this clause and affecting any of the items referred to in paragraph (1) above is accepted under this contract after the

* Insert the appropriate percentage, i.e., the contractor's share (see 1-1702.2(c)).

establishment of a firm fixed-price in accordance with paragraph (c) of the "Incentive Price Revision (Successive Targets)" clause of this contract, an equitable adjustment in the contract price and in any other affected provisions of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. If the equitable adjustment involves a reduction in the contract price, it shall be established by determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from the adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor, and reducing the contract price by ..... percent (.... %)* of such decrease. If a firm profit adjustment formula is established in accordance with said paragraph (c), the percentage set forth in paragraph (1) (ii) above may be modified for application to cost reduction proposals, submitted pursuant to this clause and affecting any of the items referred to in paragraph (1) above, which are accepted under this contract after the establishment of said formula.

(3) If an equitable adjustment pursuant to paragraph (1) or (2) above should involve an increase in the contract price, such increase shall be established under the "Changes" clause rather than this paragraph (d). The resulting contract modification shall state that it was made pursuant to this clause.

For Fixed Price contracts providing for prospective price redetermination, the clause set forth in 1-1705.1 is modified by substituting the modification to paragraph (d) as set forth in 1-1705.4.

1-1705.4 Value Engineering Incentive Clause for Fixed-Price Contracts Providing for Prospective Price Redetermination. For fixed-price contracts providing for prospective price redetermination, insert the clause set forth in 1-1705.1 above, modified by adding the following to the second sentence of paragraph (d) thereof:

provided, that for any redetermination of price, under the "Price Redetermination" clause of this contract, having an effective date subsequent to the effective date of any change order issued pursuant to this clause, the redetermined price shall not be reduced as a consequence of such change order by more than ..... percent (.... %)* of the estimated decrease in that part of the Contractor's cost of performance that is attributable to the pertinent price redetermination period.

* Insert the appropriate percentage, i.e., the Government's share (see 1-1702.2(c)).

For CPIF type contracts, the value engineering incentive clause is modified by substituting the alternate paragraph (d) as set forth in 1-1705.5.

> 1-1705.5 Value Engineering Incentive Clause for Cost-Plus-Incentive-Fee Contracts. For cost-plus-incentive-fee contracts, insert the clause set forth in 1-1705.1 above, modified to substitute the following paragraph (d) thereof:
>
> (d) If a cost reduction proposal submitted pursuant to this clause is accepted, an equitable adjustment in target cost and fee and in any other affected provision of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. The equitable adjustment in target cost and the fee shall be established by (i) determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor, and (ii) deducting the full amount of this estimated decrease from the target cost and adding ..... percent (.....%)* of such amount to the minimum target and maximum fees. If the equitable adjustment involves an increase in the cost of performance of the contract, such increase shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause.

The operation of this clause will be illustrated in Case Problem Nos. 3 and 4 later in this Chapter.

The "Value Engineering Program Requirement" clause is now given for each type of contract. Some comments made previously about the "Value Engineering Incentive" clause are equally applicable to the program clause and comments will be confined to those aspects which differ.

Paragraph (a) of the program requirement clause requires the contractor to "engage in a value engineering program and submit progress reports thereon." As previously discussed, the level of effort for this program should be specified in the contract schedule and the reporting requirements should likewise be specified in the schedule - both as to frequency and content.

From the third sentence of paragraph (a) down to paragraph (d) the program clause is almost identical to the incentive clause and will not be repeated here.

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* Insert the appropriate percentage, i.e., the Government's share (see 1-1702.2(c)).

1-1706 Value Engineering Program Requirement Clauses. If it is determined in accordance with 1-1703 to include a Value Engineering Program Requirement in a contract, the applicable clause of those set forth below shall be used.

1-1706.1 Value Engineering Program Requirement Clause for Use in Cost-Plus-Fixed-Fee Contracts.

VALUE ENGINEERING PROGRAM REQUIREMENT (AUG. 1963)

(a) The Contractor shall engage in a value engineering program, and submit progress reports thereon, as specified in the Schedule. In addition, the Contractor shall submit any cost reduction change proposals resulting from the required program.

The operation of paragraph (d) of this clause which deals with fee changes resulting from accepted cost reduction proposals will be illustrated in Case Problem No. 5.

Paragraph (e) of the clause is identical with paragraph (e) of the incentive clause

(e) Cost reduction proposals submitted under the provisions of any other contract may also be submitted under this contract for consideration pursuant to the terms of this clause.

Paragraph (f) defines all progress reports and all proposals (whether or not accepted) as "subject data" under the "Data" clause of the applicable contract. This should be compared with paragraph (f) of Section 1-1705.1 above.

(f) Any progress reports submitted pursuant to (a) above, and any value engineering proposal, including supporting data, submitted pursuant to this clause shall constitute "Subject Data" under the "Data" clause of this contract, whether or not change orders or contract modifications result therefrom. Notwithstanding any other provisions of this contract, the Government shall have the unrestricted right to apply any data pertinent to any cost reduction proposal in any manner and for any purpose whatsoever unless the Contracting Officer specifically agrees otherwise in writing.

Sections 1-1706.2, 1-1706.3, 1-1706.4 and 1-1706.5 are the various modifications to paragraph (1) of the basic clause which are required for use in other types of contracts.

1-1706.2 Value Engineering Program Requirement Clause for Use in Cost-Plus-Incentive-Fee Contracts. For cost-plus-incentive-fee contracts, insert the clause set forth in 1-1706.1 above except that paragraph (d) shall be deleted and paragraph (d) as set forth under 1-1705.5 substituted in lieu thereof. The percentages inserted in said paragraph (d) shall be in accordance with 1-1703.2.

1-1706.3 Value Engineering Program Requirement Clause for Use in Fixed-Price Incentive (Firm Targets) Contracts. For fixed-price incentive (firm targets) contracts, insert the clause set forth in 1-1706.1 above except that paragraph (d) shall be deleted and paragraph (d), as set forth under 1-1705.2, substituted in lieu thereof. The percentages inserted in paragraph (d) shall be in accordance with 1-1703.2

1-1706.4 Value Engineering Program Requirement Clause for Use in Fixed-Price Incentive (Successive Targets) Contracts. For fixed-price incentive (successive targets) contracts, insert the clause set forth in 1-1706.1 above except that paragraph (d) shall be deleted and paragraphs (d)(1) and (2), as set forth under 1-1705.3 substituted in lieu thereof. The percentages inserted in paragraph (d)(1) shall be in accordance with 1-1703.2.

1-1706.5 Value Engineering Program Requirement Clause for Use in Fixed-Price Contracts Other than Fixed-Price Incentive Contracts. For fixed-price contracts other than fixed-price incentive contracts, insert the clause set forth in 1-1706.1 above except that paragraph (d) shall be deleted and paragraph (d) of the clause set forth under 1-1705.1 substituted in lieu thereof. The percentages inserted in said paragraph (d) shall be in accordance with 1-1703.2. In addition, for fixed-price contracts providing for prospective redetermination, the following shall be added to the second sentence of said paragraph (d):

provided, that for any redetermination of price, under the "Price Redetermination" clause of this contract, having an effective date subsequent to the effective date of any change order issued pursuant to this clause, the redetermined price shall not be reduced as a consequence of such change order by more than ..... percent (.....%)* of the estimated decrease in that part of the Contractor's cost of performance that is attributable to the pertinent price redetermination period.

* Insert the appropriate percentage, i.e., the Government's share (see 1-1703.2).

The operation of Section 1-1706.2 will be illustrated in Case Problem No. 6.

## CASE PROBLEMS ON VALUE ENGINEERING

These problems are typical of the contractual aspects of value engineering. They are realistic although the company names, program titles and equipment mentioned is fictional.

### Case Problem No. 1

The Associated Electronics Company recently received a firm fixed price contract in the amount of $110,000 to build 10 airborne computers for the Air Force. While performing this contract the Associated Electronics Company did a value engineering study which concluded that the testing requirements as set forth in the contract could be considerably simplified and still retain the same degree of reliability assurance. Since the test requirements that are presently in the contract would have to be amended to permit this simplified testing procedure, a value engineering proposal was submitted to the Air Force outlining the proposed test procedure revision and including an estimate that the testing costs could be reduced from $1,000 to $500 per unit. To accomplish this cost reduction, the original test equipment would have to be modified at an estimated cost of $3,000, including test procedures, etc. The Air Force has now accepted the Associated Electronics Company's proposal. Paragraph (d) of the Value Engineering Incentive clause in this contract reads as follows:

> (d) If a cost reduction proposal submitted pursuant to this clause is accepted under this contract, an equitable adjustment in the contract price and in any other affected provisions of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. If the equitable adjustment involves a reduction in the contract price, it shall be established by determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from the adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor, and reducing the contract price by fifty percent (50%) of such decrease. If the equitable adjustment involves an increase in the contract price, such increase shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause. (ASPR 1-1705.1(d))

Problem: Compute the revised contract price.

Case Problem No. 2

The Space Electronics Company recently received a fixed price incentive contract to build 10 field switchboards for the Army. The target cost of this contract is $100,000, the target profit is $10,000, the ceiling price is 125 percent of target cost and the share line is 70/30 (i.e., 70 percent is the Government's share). In performing this contract, a value engineering study by Space Electronics has concluded that the fabrication of their switchboards could be considerably simplified by using printed circuit boards and still perform with the same degree of reliability. Since the contract would have to be amended to permit using the printed circuit boards, a value engineering proposal was submitted to the Army including an estimate that the fabrication costs could be reduced from $1,000 to $500 per unit. The cost of implementation is estimated at $3,000, including process sheets, etc. The Army has now accepted Space Electronic's proposal.

Paragraph (d) of the Value Engineering Incentive clause in this contract reads as follows:

> (d) If a cost reduction proposal submitted pursuant to this clause and affecting any of the items described in paragraph (a) of the "Incentive Price Revision (Firm Target)" clause of this contract is accepted under this contract, an equitable adjustment in the total target price of such items and in any other affected provision of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. The equitable adjustment in such total target price shall be established by (i) determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor, and (ii) deducting the full amount of this estimated decrease from the total target cost and adding fifty percent (50%) of such amount to the total target profit relating to such items. The maximum dollar limit on the total final price of such items, which is expressed in said paragraph (a) as a percentage of the total target cost thereof, shall be increased by the total amount of any adjustments in the total target profit that have been established pursuant to this clause. If the equitable adjustment involves an increase in the contract price, such increase shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause. (ASPR 1-1705.2(d))

Problem: a) Compute the revised target price.

b) Compute the revised ceiling percentage.

c) Compare the revised target price computation with the computation of Case Problem No. 1.

d) Prepare a graphic presentation of the contract incentive structure before and after the value engineering change proposal.

Case Problem No. 3

The Navy has awarded a cost-plus-incentive-fee contract to the Aerospace Electronics Company for the research and development of a miniaturized UHF receiving set.

The target cost of this contract is $1,000,000, the target fee is $80,000, with the target fee to be increased by 25 cents for every dollar by which the total allowable cost is less than the target cost up to a maximum fee of 12 percent of target cost. The target fee is to be decreased by fifteen cents for every dollar by which the total allowable cost exceeds the target cost, with a minimum fee of 4 percent of target cost.

During the performance of this contract Aerospace Electronics submitted a value engineering proposal to amend the design specification by eliminating a particular technical requirement which is no longer considered essential to the performance, quality, maintainability, reliability, standardization or interchangeability of the UHF receiver. The Navy has accepted the proposal.

Paragraph (d) of the value engineering incentive clause in this contract reads as follows:

> (d) If a cost reduction proposal submitted pursuant to this clause is accepted, an equitable adjustment in target cost and fee and in any other affected provision of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. The equitable adjustment in target cost and fee shall be established by (i) determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor; and (ii) deducting the full amount of this estimated decrease from the target cost and adding fifty percent (50%) of such amount to the minimum, target and maximum fees. If the equitable adjustment involves an

increase in the cost of performance of the contract, such increase shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause. (ASPR 1-1705.5(d)).

Aerospace Electronics Company's estimate of the gross cost reduction is $30,000 and the total implementation costs are estimated at $1,000.

Problem: a) Compute the revised target cost.

b) Compute the revised minimum target and maximum fees.

c) Prepare a graph which shows the contract incentive structure before and after the value engineering change proposal.

d) Compute the revised target cost and fee structure if the contract did not contain a value engineering contract provision.

Case Problem No. 4

Utilize the fact situation of Case Problem No. 3, except that the value engineering share is 75 percent to the Government and 25 percent to Aerospace Electronics (75/25).

Problem: a) Compute the revised target cost.

b) Compute the revised minimum, target and maximum fee.

c) Compare with Problem No. 3

Case Problem No. 5

The Acme Laboratories Company has received a cost-plus-fixed-fee contract from the Air Force for the Phase I design and development of a floated rate inertial gyro compass. The estimated cost of this contract is $1,000,000 and the fixed fee is $70,000. The contract includes a value engineering program requirement, and a share line for cost reductions under this clause of 90 percent to the Government and 10 percent to the contractor (90/10).

The value engineering group assigned to this program have generated a proposal which the Air Force has accepted. The net cost reduction, taking into account the total cost of implementation, is estimated at $8,000.

The "Value Engineering Program Requirement" clause in this contract contains the following provision:

(d) If a cost reduction proposal submitted pursuant to this clause is accepted under this contract, an equitable adjustment in the fixed fee and in any other affected provision of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. If the adjustment involves a reduction in the cost of the contract, the equitable adjustment in the fixed fee shall be established by (i) determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor; and (ii) adding ten percent (10%) of such amount to the fixed fee. If the equitable adjustment involves an increase in the cost of performance of the contract, such increase shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause. (ASPR 1-1706. 1(d))

Problem: Compute the revised fixed fee.

Case Problem No. 6

The American Armament Company has received a cost-plus-incentive-fee contract from the Air Force for the Phase II development and prototype production of the reconaissance system for the B-84 bomber.

The target cost of this contract is $1, 000, 000, the target fee is $80, 000 with the target fee to be increased by 20 cents for every dollar by which the total allowable cost is less than the target up to a maximum fee of 12 percent of target cost, and with the target fee to be decreased by fifteen cents for every dollar by which the total allowable cost exceeds the target cost with a minimum fee of 4 percent of target cost. The contract includes a value engineering program requirement with a specified level of 3, 500 manhours.

The following paragraph (d) is of the applicable portion of the "Value Engineering Program Requirement" clause in the contract:

(d) If a cost reduction proposal submitted pursuant to this clause is accepted, an equitable adjustment in target cost and fee and in any other affected provision of this contract shall be made in accordance with this clause and the 'Changes" clause of this contract. The equitable adjustment in target cost and fee shall be established by (i) determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor; and (ii) deducting the full amount of this estimated decrease from the target cost and adding

twenty percent (20%) of such amount to the minimum, target and maximum fees. If the equitable adjustment involves an increase in the cost of performance of the contract, such increase shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause. (ASPR 1-1706.2(d))

The value engineering group assigned to this program have generated a proposal which the Air Force has accepted. The net cost reduction, taking into account the total cost of implementation, is estimated at $15,000.

Problem: a) Compute the revised target cost.

b) Compute the revised minimum, target and maximum fees.

Case Problem No. 7

Compare the data provisions of the "Value Engineering Incentive" clause with the data provisions of the "Value Engineering Program Requirement" clause.

Value Engineering Incentive

ASPR 1-1705.1(f)

(f) The Contractor may restrict the Government's right to use any sheet of a value engineering proposal or of the supporting data, submitted pursuant to this clause, in accordance with the terms of the following legend if it is marked on such sheet.

This data furnished pursuant to the value engineering incentive clause of contract _____ shall not be disclosed outside the Government, or be duplicated, used, or disclosed in whole or in part, for any purpose other than to evaluate a value engineering proposal submitted under said clause. This restriction does not limit the Government's right to use information contained in this data if it is or has been obtained from another source, or is otherwise available, without limitations. If such a proposal is accepted by the Government by issuance of a change order under the "Changes" clause of said contract after the use of this data in such an evaluation, the Government shall have the right to duplicate, use, and disclose any data pertinent to the proposal as accepted, in any manner and for any purpose whatsoever, and have others so do.

After the issuance of a change order accepting a value engineering proposal, but not prior thereto, such proposal and

the supporting data shall, for the sole purpose of supplementing the rights granted to the Government under this paragraph, be considered "Subject Data" within the meaning of the "Data" clause of this contract.

Value Engineering Program Requirement

ASPR 1-1706.1(f)

(f) Any progress reports submitted pursuant to (a) above, and any value engineering proposal, including supporting data, submitted pursuant to this clause shall constitute "Subject Data" under the "Data" clause of this contract, whether or not change orders or contract modifications result therefrom. Notwithstanding any other provisions of this contract, the Government shall have the unrestricted right to apply any data pertinent to any cost reduction proposal in any manner and for any purpose whatsoever unless the Contracting Officer specifically agrees otherwise in writing.

Problem: a) Prepare a brief outline of the differences between the two clauses.

Case Problem No. 8

The Army has recently awarded Dynamic Motors Company a firm fixed price contract for the production of 1,000 heavy duty five ton trucks. Delivery is over a three year period and the negotiated unit price is $10,000. The contract contains a Value Engineering Incentive provision with a share line of 25/75 (25 percent to the Government and 75 percent to the Contractor).

Paragraph (d) of the "Value Engineering Incentive" clause in the contract reads as follows:

(d) If a cost reduction proposal submitted pursuant to this clause is accepted under this contract, an equitable adjustment in the contract price and in any other affected provisions of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. If the equitable adjustment involves a reduction in the contract price, it shall be established by determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from the adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor, and reducing the contract price by twenty-five percent (25%) of such decrease. If the equitable adjustment involves an increase in the contract price, such increase

shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause.

The contract also contains the following clause entitled "Subcontractor Value Engineering."

(a) The Contractor agrees to include in subcontracts hereunder, to the extent the contractor considers practical, a subcontractor value engineering provision consistent with the principles of ASPR Section I, Part 17, as further implemented herein:

(1) In each such subcontractor value engineering provision (i) the established percentage of the subcontractor's value engineering incentive sharing shall not exceed the limits provided in the referenced ASPR appropriate to the nature and type of subcontract, and (ii) the established percentage of the subcontractor's value engineering incentive sharing shall be based upon the total estimated decrease in the subcontractor's cost of performance (taking into account the subcontractor's estimated cost of implementing the change), less the contractor's estimated cost of implementing the change (excluding the amount of the subcontractor's value engineering incentive adjustment).

(2) Any subcontractor initiated cost reduction proposal which involves changing the drawings, designs, specifications or other requirements of this contract, and which is favorably considered by the Contractor, (i) shall be submitted as a Contractor initiated and developed cost reduction proposal under the "Value Engineering Incentive" clause of this contract and (ii) shall be subject to the provisions thereof, as further implemented herein. For any such Contractor initiated and developed cost reduction proposal accepted by the Government, the reasonable amount of the subcontractor's value engineering incentive adjustment shall be considered as part of the Contractor's estimated cost of implementing the change.

(3) Any subcontractor initiated cost reduction proposal which does not involve changing the drawings, designs, specifications, or other requirements of this contract, (i) shall not require the Government's approval for acceptance by the Contractor, and (ii) shall not be submitted as a Contractor initiated and developed cost reduction proposal under the "Value Engineering Incentive" clause of this contract. For any such subcontractor initiated cost reduction proposal accepted by the Contractor, the reasonable amount of the subcontractor's value engineering incentive adjustment shall be considered as part of the Contractor's cost of performing this contract (without price adjustment).

Dynamic Motors has subcontracted with Kalamazoo Motors for the truck engines. The firm fixed price subcontract with Kalamazoo is for 1,000 engines at $450 each. The Kalamazoo subcontract contains a Value Engineering Incentive provision with Kalamazoo to retain 60 percent of the net cost reduction after taking into account any implementation costs to Dynamic Motors.

Kalamazoo has now come out with a new aluminum block engine on its own truck line. This engine is considered to be a substantial improvement over the previous cast iron block design. Rather than retain the old production line to supply the 1,000 engines to Dynamic Motors, the Kalamazoo production people have asked Dynamic Motors if they will accept the new engines in lieu of the model which is on order.

Dynamics Motors examined their contract and found that the cast iron engine block was specified in their contract. Since Dynamic Motors will have to obtain a change to the prime contract specification to accept the Kalamazoo proposal, they suggested that Kalamazoo write up their offer as a value engineering proposal.

Kalamazoo's proposal, in addition to presenting a detail comparison of the cast iron engine block and the aluminum block engine, estimated a gross cost reduction on the 1000 units of $25,000 and implementation costs to Kalamazoo of $500. Dynamic Motors submitted this proposal to the Army under the value engineering provision of the prime contract. Dynamic Motors estimated its cost for implementation at $4,000.

Problem:

a) Compute the revised subcontract price if the above proposal were accepted.

b) Compute the revised contract price if the above proposal were accepted.

c) What would be the result if Dynamic Motors did not require a specification change in order to utilize the aluminum block engine?

d) Discuss the consequences if Dynamic Motors is awarded a follow-on contract for 1,000 more trucks after completion of the original contract with the accepted change proposal. The same value engineering provisions prevail and the same subcontracts let except:

(1) the follow-on contract calls for cast iron blocks.

(2) the follow-on contract calls for aluminum blocks.

Case Problem No. 9

The Hayman Manufacturing Company was recently awarded a firm fixed price contract for 10,000 field radio receivers at a unit price of $26.25 (total contract price $262,500). The Army awarded this contract on a price competition basis, using a detailed set of production drawings.

Internally, the Hayman marketing group had developed their price as follows:

| | Unit Basis |
|---|---|
| Material $130,400/10,000 | $13.04 |
| Material Handling at 10 percent | 1.30 |
| Labor: | |
| Assembly -- 44 minutes per unit at 90 percent efficiency at $2.40 per man-hour | 1.94 |
| Test -- 20 minutes per unit at $3.00 per man-hour | 1.00 |
| Burden at 175 percent | 5.15 |
| Industrial Engineering -- 500 hours at $4.00 per man-hour/10,000 | .20 |
| Engineering Burden at 100 percent | .20 |
| Subtotal | $22.83 |
| Profit at 15 percent | 3.42 |
| Selling Price | $26.25 |

The industrial engineering group at Hayman Manufacturing noticed that their biggest production problem was in the assembly of units. In soldering certain resistors into position the heat from the soldering operation was affecting certain nearby capacitors. To solve this problem, they recommended mounting the capacitors on a printed circuit card which could be inserted after the soldering operation. This assembly method would not only reduce their present rejection rate on finished units, but would also reduce the total assembly time by about 3 minutes per unit. To implement this new assembly process they estimated that about 100 hours of industrial engineering would be required to write up the new process sheets. The estimated cost of buying the capacitors mounted on a plug-in board is $.50 each compared with their present cost of $.40 each. Also, the

Hayman people estimated that this rearrangement in this internal construction of the unit would save the Army an estimated $1,000 a year in maintenance costs.

Paragraph (b)(iv) and paragraph (d) of the value engineering incentive provision reads as follows:

> (iv) a prediction of any effects the proposed change has on other costs to the Government, such as Government-furnished property costs, costs of related items, and costs of maintenance and operation:
>
> (d) If a cost reduction proposal submitted pursuant to this clause is accepted under this contract, an equitable adjustment in the contract price and in any other affected provisions of this contract shall be made in accordance with this clause and the "Changes" clause of this contract. If the equitable adjustment involves a reduction in the contract price, it shall be established by determining the amount of the total estimated decrease in the Contractor's cost of performance resulting from the adoption of the cost reduction proposal, taking into account the cost of implementing the change by the Contractor, and reducing the contract price by forty percent (40%) of such decrease. If the equitable adjustment involves an increase in the contract price, such increase shall be established under the "Changes" clause rather than under this paragraph (d). The resulting contract modification will state that it is made pursuant to this clause.

Problem: Prepare the data for a value engineering proposal for Hayman Manufacturing to submit to the Army.

## CONTRACT NEGOTIATION WORKSHOP

A fictitious, but realistic, problem that is suitable for a group practical exercise is presented in this section. For this problem the group is divided into teams of about six each. Half are designated as "contractor negotiation teams" and the other half as "Government negotiation teams." Each team develops a negotiation position on the proposed procurement described after this discussion. After each group has had time to develop the subject, they present their position with a brief oral explanation of their objectives. An outline of the major factors may be placed on a blackboard as follows:

| Contractor Teams | | Item | Government Teams | |
|---|---|---|---|---|
| Team #1 | Team #2 | | Team #3 | Team #4 |
| | | Contract Type | | |
| | | Cost Incentive | | |
| | | Performance Incentive | | |
| | | Delivery Incentive | | |
| | | Value Engineering Contract Provision | | |
| | | Program level of effort | | |
| | | Value Engineering Share line | | |

At least one contractor and one Government team may then orally negotiate a definitive contract with the other teams participating as "corporate office" and "Headquarters" support groups.

Some of the factors which should be considered in working the problems are:

A. The desirability of a value engineering program in Phase II, particularly in view of the $30, 000, 000 Phase III effort.

B. The effect a cost incentive in Phase II may have on the ultimate Phase III cost.

C. The feasibility of writing Phase II and III as one fixed price incentive type contract to motivate the lowest possible unit cost in Phase III.

D. Delivery incentives as a penalty only.

E. Performance incentives as a bonus for increasing the reliability factor.

Contract Negotiation Workshop.

The Project Definition Phase of the Star-Fish Program was awarded as parallel fixed-price contracts to Space Electronics Company and to the Advanced Engineering Company. Both firms are in final stages of their Project Definition Phase and are now preparing proposals for building ten prototype Phase II Star-Fish units and to design and fabricate the special tooling necessary for a production run of 1,000 Star-Fish units in Phase III.

On the basis of the Phase I tests which were conducted on the developmental units of both firms, the Government has decided to initiate negotiations for Phase II with Space Electronics. Space Electronics has been requested to propose a contract schedule which will best facilitate the Government's objectives for the Star-Fish program.

The Space Electronics estimating group has developed the following cost figures:

10 Prototype Units built to the Phase I design configuration:

| Estimated Cost | Probability that the Estimated Cost will be Exceeded |
|---|---|
| $ 900,000 | 90% |
| 1,000,000 | 50% |
| 1,200,000 | 20% |

Special tooling for 1,000 Phase III units built to the Phase I design configuration:

| Estimated Cost | Probability that the Estimated Cost will be Exceeded |
|---|---|
| $ 900,000 | 90% |
| 1,000,000 | 40% |
| 1,100,000 | 10% |

The estimated unit cost for the 1,000 units is $30,000 based upon the Phase I design configuration.

A reliability factor of 95 percent was the original design objective for the Star-Fish Program, however, the Government is satisfied with the 90 percent reliability factor established by the Phase I test data.

The Phase III units are to be installed in the B-84 bomber, with the first units being scheduled for installation eighteen months from now. The Phase II units are prototypes which will be used for additional tests.

Using the above data, each negotiation team is to develop negotiation objectives in the area of:

A. Contract type.

B. Cost incentives.

C. Performance incentives.

D. Delivery incentives.

E. Value engineering contract provisions.

F. If the value engineering program requirement is utilized, what level of effort should be required?

G. What value engineering share line is to be utilized and should this share line be the same as the overall contract cost incentive?

## ASPR PROVISIONS FOR VALUE ENGINEERING: SUMMARY

A. The Armed Services Procurement Regulation (ASPR) provides policy and clauses in Part 17 of Section I for uniform application of value engineering in DoD contracts.

B. The ASPR states that it is DoD policy to incorporate value engineering provisions in all contracts which offer a reasonable likelihood for cost reduction.

C. Two types of value engineering contract provisions are: a) "Value Engineering Incentive" clause which provides for sharing of cost reductions which result from contractor generated and Government approved proposals which change contractual requirements, and b) "Value Engineering Program Requirements" clause which obligates the contractor to perform certain tasks and which also allows sharing as above, but provides a smaller percentage for the contractor.

D. "The principal goal of a value engineering program requirement clause is to realize the potentialities of value engineering. . . at a time when it will do the most good, i. e., in the initial stages of the design-development-production cycle. . . ."

E. Value engineering incentive provisions provide a mechanism and incentive for a contractor's efforts to propose savings which can be achieved only by changing a contractual requirement.

F. Value engineering incentive provisions are exclusive of the cost performance and delivery incentive provisions of FPI and CPIF contracts.

G. The Government will bear a reasonable and allocable share of the cost of contractor value engineering programs.

H. The cost of a contract with a value engineering program requirement clause may include ". . . an amount specifically to cover a required value engineering program. . . ."

# CHAPTER 6: PROGRAM ADMINISTRATION AND MANAGEMENT

This Chapter discusses some of the basics of administering and managing value programs... the aspects presented are annotated for their applicability to value programs in industry and in the DoD... Contractor funding is analyzed for various contractual situations as derived from the ASPR... and as separate procurements... Subcontractual value engineering usage is introduced... some areas of special attention are noted... Value engineering personnel selection criteria and... duties are presented... Some guidelines are offered for the organizational aspects of value engineering... Program control elements of planning... motivation... and information services are described... Details of the results of value engineering efforts... and an approach to assessment are given.

# CHAPTER 6

# PROGRAM ADMINISTRATION AND MANAGEMENT

## CONTRACTOR FUNDING

This section will discuss some of the funding aspects of value engineering programs and value engineering task elements. This Guide is not a definitive treatment. The discussion is based upon the regulations available at time of publication, especially the ASPR, but it represents interpretations of these documents. Some of the mechanics of value engineering funding, as of many other elements of defense procurements, are to a large extent a matter of local option. This section will present some guidelines for determining reasonableness of funding, some historical aspects and interpretations of the ASPR. Specific decisions for localized application should be consistent with the contractor's costing procedures approved by the cognizant Government fiscal authority.

This section will treat funding for "Value Engineering Incentive" clause coverage and "Value Engineering Program Requirement" clause coverage separately. In either event determination of funding for a particular contractual situation should be based upon assurances that a technically proper value engineering effort is contemplated. Funds provided ostensibly for value engineering should not be used for efforts which are not compatible with the spirit or letter of the Government regulations.

### Contracts with a "Value Engineering Incentive" Clause.

Value engineering efforts on contracts which contain "Value Engineering Incentive" clauses should not be a direct charge. ASPR Revision 3, dated 15 November 1963, specifically states that the Government will "... bear

a reasonable and allocable share of the cost." The word allocable indicates an overhead rather than direct charge. Additionally, if the contractor's previously approved accounting procedure is to charge value engineering as an overhead item, contracts with value engineering incentive clauses would then not list value engineering as a line item of direct cost. The ASPR also states that the inclusion of the clause should not increase the cost of the procurement.

Cost of Value Studies. The question frequently arises concerning the cost allowability of the study effort leading to value engineering change proposals. As previously stated, if value engineering is being charged as an item of overhead, the cost of the studies should be also an item of overhead. The sharing percentage for a "Value Engineering Incentive" clause is allowed to go as high as 75 percent to the contractor. This reflects consideration of the contractor's risk in the performance of the studies which lead up to the opportunity to share under the clause.

The ASPR allows the contractor to deduct certain implementation costs associated with making cost reduction changes approved by the Government. It is conceivable that some of these costs could be for the value engineering personnel directly concerned with implementing approved changes. In this case it seems reasonable that such costs could be reflected as direct charges to the cost of implementing a cost reduction change. However, this would cover only the cost following the change approval and would not be a readily determinable part of the contract price during award or negotiations.

"Value Engineering Program Requirement" Clause Coverage.

Type of Funding. The "Value Engineering Program Requirement" clause itself directs the contractor to "... engage in a value engineering program, and submit... reports..." This language is typical of the basis for the generation of other items normally charged direct. The value engineering efforts here would be on the particular contract in question and, therefore, would reasonably be direct charges. The Government is contracting for a value engineering program to be described in the contract schedule as a definitive statement of work. It should be priced in the same manner as any other element of direct program performance.

The "Value Engineering Program Requirements" clause has provision for contractor sharing of accepted proposals which change contract requirements and reduce the contract cost. However, the sharing percentages provided by ASPR are considerably lower for contracts with the requirements clause than for those with the incentive clause. This is another reflection of the reduction in contractor risk which is a corollary of direct funding.

Funding Limits. Government regulations now in force do not establish limits for direct funding on contracts with a "Value Engineering Program Requirement" clause. The previous ASPR provision in Revision 13 to the 1960 Edition, did contain funding limits which were based upon the annual contract value. For historical interest, they averaged about .8 percent of the contract dollar for contracts under 10 million and about .2 percent for contracts over 10 million dollars. Department of Defense Handbook H-111 has words about the determination of the level of value engineering effort. It states that, "Experience to date indicates that a budget of from 1/10 of one percent to 1/2 of one percent of total annual dollar volume is an appropriate level..." Handbook H-111 is not a regulatory document. It does not contain many of the task elements which have since been developed and are being used as parts of value engineering programs. Therefore, its guidance should not be applied arbitrarily. The most likely situation for current and near future contracting of value engineering programs is that the figures previously mentioned in the now obsolete ASPR Revision 13, and especially those in H-111, are low.

Price Analysis. The proper amount of direct funding should be determined in each contractual situation according to the specific tasks to be performed. These tasks will need to be described in the Schedule of the contract as required by ASPR. The determination of the appropriate direct funding becomes a price analysis task similar to the determination of funding for any other direct element of the contract. The value engineering task elements need to be defined, scheduled and priced in a manner which will permit price analysis and negotiation of the value engineering task.

There are some special factors that need be considered for price analysis of the value engineering task. The value engineering effort needs to be sufficiently well identified to assure the Government that the funding

providing for their performance is consistent with value engineering requirements. ASPR uses value engineering to mean, "...a cost reduction effort not required by any other provision of the contract." Therefore, the DoD agency needs to assure itself that the value engineering tasks for which separate direct funding is being provided, are in fact, consistent with a proper value engineering program. Care should be taken to assure that funds are being provided for identified value engineering personnel and value engineering tasks rather than for tasks which are reflections of other efforts required elsewhere in the contract. Portions of the contractor's value engineering program which will serve several contracts, or which are normal overhead items, should not be duplicated in the direct budget.

Ratio of Return. Value Engineering literature, including H-111, speaks of the ratio of dollars returned by value engineering to the dollars spent for value engineering. H-111 states that this ratio should exceed ten dollars recovered for every dollar spent. Value engineering program requirements are not typical of the efforts which can always provide a measured determination of results in dollar units. Furthermore, the Government is contracting for a value engineering program as a set of tasks, rather than for a specified ratio of return. Therefore, returns on investment figures are not a logical basis for the establishment of direct funding at this time.

Other Direct Costs. Value engineering program tasks do not normally involve materials, fabrication or test. Therefore, these items would normally not appear in the direct value engineering costs. It is possible, in isolated cases, that direct material charges may be involved for the fabrication of models or mock-ups. Other direct costs, such as fabrication or testing, which may be associated with the implementation of value engineering change proposals will not normally be an item of direct cost at the time of contract establishment. The allowability of these costs when they are approved to occur is contained in the incentive provision language of the clause. It provides that these costs will be deducted from the gross cost reduction stated by cost reduction proposals (VECP's). Value engineering direct funding should be almost exclusively equivalent to the time charges of value engineering personnel.

Other Factors

There are some considerations of value engineering funding which may be derived from the ASPR but which are not associated with a specific contract. ASPR states that "... when a contractor does not have a value engineering program in existence, proper allocable costs of instituting a reasonable value engineering program are allowable." This is interpreted here to mean that the efforts to initiate a value engineering program should be allowed as an item of cost in the audit of overhead expenses performed by the cognizant Government agency. These costs, which may involve consultants, attendance of limited numbers of personnel at training programs held outside of the organization, travel for purposes of obtaining data on other value engineering programs, and preparation of company procedures for implementing a value engineering program, would fall into this category. These represent some of the start-up costs and should normally appear in the overhead or burden category.

Fee or Profit.

The argument which derives value engineering as a line item of direct cost on a contract with a "Value Engineering Program Requirements" clause would seem to carry on to provide an opinion concerning fee or profit. Since fee or profit is related in current practice to direct costs, it would appear that contractors are entitled to this also on their contracts which have program requirement clauses. These may, of course, appear in fixed price, as well as in cost reimbursement contracts. These contracts may or may not have profit incentives based upon final contract cost. Incentive contracts provide additional fee for successful efforts which cause the final costs to be lower than a predetermined target. A contractor may then be in the position of gaining a fee for his value engineering program efforts to reduce final contract costs and then gaining fee by virtue of the cost incentive for his successful cost reductions. This is not a fee-on-fee; it is an incentive situation and it is allowable. The Government, of course, gains the greater share of these achieved economies since their portion of the contract underruns on incentive contracts is generally in the region of 80 percent of the underrun. The fee given for the performance of the value engineering program requirements represents the contractor's profit for

the specific tasks which he and the Government both feel will produce meaningful contract cost underruns.

These situations should not be confused with the sharing of savings under the value engineering incentive provisions of the program requirement clause. The contractor can obtain this gain only when he proposes cost reductions which require contract changes, and, the Government accepts them. The value engineering program tasks in the contract schedule need to be carefully analyzed to assure that the contractor's efforts for which he is being given a direct funding and a fee are properly oriented towards achieving contract cost underruns within the requirements of the contract rather than towards obtaining contract changes which the contractor will share to an equal or higher percentage under the incentive provision of the "Value Engineering Program Requirements" clause.

Value Engineering Service Contracts.

The previous discussions have all considered value engineering as an included element of a procurement. It is also possible to have a procurement solely for value engineering services. This may be obtained from industry, educational institutions and consultants. Agencies of the DoD have utilized this mechanism to contract for several categories of services or equipment: a) value training support and complete Workshop exercises, b) value research studies, c) value program development consultation, and d) value engineering studies of specified equipment projects.

Separate contracts for these or other possible situations are treated as individual procurements. The contract type, structure and procurement method would be appropriately selected as prescribed by the ASPR and the implementing regulations of the procuring activity.

The use of a separate procurement for the first three cases cited above needs little amplification. They represent identifiable services which can be contract items in themselves. Value engineering studies may be separate procurements for several reasons: a) the project for study may be a DoD in-house developed item which may or may not be planned for fabrication by industry, b) re-procurement of an existing item may be anticipated, pre-procurement study is felt to be justified and is more amenable to outside than to DoD value study, c) a fresh look at an item in addition to or,

by other than, the original developer or producer may achieve more varied results, or d) it is considered desirable to contractually separate the value engineering portion of a contract in order to effect easier control, a different type of contract instrument or assessment of results.

In any event, the statement of work or other task description in the contract schedule should clearly specify the task. Contracts for value studies usually identify the item to be studied and may call for submission of mock-ups, working models or prototypes of the contractor's recommended value improvement.

## SUBCONTRACTUAL ASPECTS

The logic of the previous discussions on the application of value engineering clauses to prime contracts also applies to subcontracts. Prime contractors place 40 - 50 percent of their Government contract dollars with other companies. They procure materiel and services of the same types as the DoD. This covers the range from standard commercial catalog items through R & D to exploratory research. Much of these procurements, especially for "off the shelf" items, are by instruments called 'purchase orders.' In fewer cases, but of individually much larger dollar value, prime contractors negotiate other instruments called contracts with other companies under the terms and conditions of their contract with the Government.

All prime contractor procurements may be legally considered as subcontracts. Purchase orders have many of the technical legal aspects of a contract. This section, however, will only discuss prime contractor procurements of items outside the off-the-shelf category and specifically designated as subcontracts. The value engineering aspects of these procurements are applicable to the purchase order situation in theory, but represent a later step in practical consideration.

### Government Posture Towards Subcontracts.

Subcontracts are commercial contracts; they are not Government contracts. The Government is not a party to them except as they may be approved by the contracting officer under certain circumstances. The Government pays the prime contractor a fee or profit on his subcontractual costs which emphasizes the delegation of management authority from the

Government to the prime contractor. Without raising all of the finer points of this broad interface, it can be said that one of the major considerations is that subcontractors are not to have formal access to the Government as represented by the contracting officer.

The Government does place certain subcontractual constraints upon prime contractors. These, in general, have to do with placement of some ASPR clauses in subcontracts and contracting officer approval of some subcontracts issued under specific types and sizes of prime contracts. The applicable rules are provided in the ASPR.

ASPR Provisions for Value Engineering in Subcontracts.

Part 17 of Section I of the ASPR does not mention its use in subcontracts, nor did previous editions of the ASPR on value engineering. Some of the rationale may be understood by considering the general attitude toward subcontracts.

A value engineering change proposal (VECP) is submitted and implemented under the "Value Engineering Incentive" Clause or provision of the prime Government contract. The prime contractor is restrained from relief via the ASPR "Disputes" clause of the contract for VECP acceptance or rejection decisions by the contracting officer. But, if the change subsequently leads to an increase in the contract price, it would be accomplished under the "Changes" clause. This clause provides for prime contractor appeals for relief in case of a dispute over the equitable adjustment. It is also possible that the contractor may seek relief under the "Disputes" clause from the amount which the Government determines is the base for the sharing of approved VECP's. The "Disputes" clause as stated in the ASPR may not be in subcontracts because it would provide the subcontractor with direct access to the Government.

A subcontractor generated VECP may require a change in the prime contract as well as in the subcontract. Any dispute arising from such a "subVECP" could involve the Government beyond its usual practice or wishes.

Subcontractual Value Engineering Clauses.

At the time of publication of this Guide, subcontractual value engineering arrangements are contractor prerogatives except that the entire

subcontract may be subject to contracting officer approval for other reasons. There are some local military organizations with directives on value engineering clauses for subcontracts. These are not wholly satisfactory.

> (This problem was under active study by the DoD when this Guide was published. Although no official policy was available, it was thought to be appropriate to discuss some operating considerations that might prevail until the ASPR would be amended.)

Nothing in the ASPR, or elsewhere of equal or higher authority, forbids the placement of value engineering clauses in subcontracts. The ASPR arguments which derive the necessity for and the use of value engineering contractual arrangements apply equally to the subcontractual situation. Thus, each subcontract should be considered for value engineering clause coverage. A possible test would be to determine if it would qualify for this coverage if it were a prime contract. The type of value engineering provision would be selected on the same basis as for prime contracts, i.e., either the program requirements type or the value engineering incentive type.

Program Requirements Clause. Subcontractual charges for required value engineering efforts would be treated in the manner as any other subcontractual expense. It would not be mandatory that the prime have a program requirement provision in his contract, and hence, direct funding for value engineering, in order for him to include this effort in a subcontract.

The prime contract as an entity may be suitable for an incentive clause, but one of its subcontracts may be a portion that would produce greater benefits from a required program. The type of prime contract also has a bearing. Fixed price contracts provide wider latitude for the prime contractor to dispense his funds to accomplish the basic contract than do cost reimbursement contracts. He may exercise this prerogative with respect to obtaining value engineering benefits from his subcontractors. The most straightforward case is, of course, one in which a prime with a program requirement clause places a value engineering requirement upon a subcontractor. In effect, he shares the overall contractual value engineering direct budget with the subcontractor.

"Value Engineering Incentive" Clause. No DoD approved or standard clause language exists at this time for use in subcontracts and it is not within the

scope of this Guide to create any. However, some further examination of the problem is in order to facilitate review of prime contractor clauses when these are subject to Government approval.

Subcontractor generated VECP's will require a change in the subcontract. This change may or may not affect the prime contract. If it can be implemented without changing the prime contract it is strictly a commercial transaction. Contractor and subcontractor would be able to share as they see fit.

The Government would gain from this situation only if the prime contract were a fixed price incentive contract or a cost reimbursement contract (with or without incentives). In these cases the final prime contract cost would be lower than was originally expected, by the amount of the prime contractor's share of the cost reduction less his implementation costs. The Government would share this net amount with the prime contractor according to the price adjustment formula of an incentive contract or would gain the entire net amount on cost reimbursement contracts without incentives.

The situation is quite complex if the subcontractor generated VECP is such that it cannot be implemented by the prime unless the Government changes the prime contract. The prime would have to submit the VECP to the Government under its value engineering incentive provision. If it were approved and shared in accordance with the prime sharing percentages, the amount left for the prime to share with the subcontractor would be less, for example by 50 percent, than what the subcontractor had originally envisioned. He had risked his funds to make the study on the strength of sharing in the net savings to the percentage stated in his contract with the prime.

Subcontractual value engineering clauses must make adequate and equitable provisions for the situation above. This is not an unlikely case and has already occurred several times. Past practice in at least one case, by local option, was to allow the prime his costs of implementing the subcontractor's VECP and no direct share in the saving. However, this was an incentive contract and the prime did obtain a gain from the lower cost of contract performance.

PERSONNEL

This section will discuss the selection, training and duties of value engineering personnel, i. e., those who have one or more value engineering program elements as their assigned primary responsibility. They are members of a designated value engineering group and have 'value engineering' as their job description. The factors noted below are guidelines based upon current practices and past experiences.

Selection.

Previous Experience. A candidate should have previous experience in one or more of the major specialty areas that he is most likely to deal with. Previous assignments in procurement, logistics, finance, fabrication or price analysis are helpful. His knowledge of the personnel, operation, problems and jargon facilitates communication. This is especially useful if these were gained with the installation that is considering him for a value engineering assignment.

Personality. Character traits are the most significant selection criteria. This results from the nature of the value engineering task. The performance of value studies and the development of procedures for value assurance activities by other personnel require extensive personel contact with numerous people from several of the organizational elements. The ability to successfully accomplish these contacts and to react in a positive, constructive manner cannot be overemphasized.

Personality traits which are positive selection factors include:

a) Capacity to deal with people without arousing antagonism.

b) Sensitivity to the personal viewpoint that others have of the value problem and its implications to them.

c) Initiative to undertake tasks of known difficulty in previously unexplored areas.

d) Willingness to be identified with a group that is involved with perturbing the status quo.

e) Articulate in oral and written expression.

f) Not easily discouraged and possess the capability to rebound when discouraged.

g) Maturity of thought and action (which may have no positive correlation with chronological age).

Formal Education. A university degree is a desirable, but not mandatory, prerequisite. If the assignment is expected to be mostly value studies, design reviews, or specification reviews of advanced technology items, an appropriate technical degree is certainly useful. When, however, the major effort will be to help cost-determining people to do their own value engineering, a formal technical education diminishes in importance to other criteria. A degree does provide evidence that one otherwise personally unknown to the selector has been exposed to and has demonstrated the knowledge and diligence needed to complete a college curriculum. No college offers an undergraduate degree in value engineering at this time.

Value Training. Universities, consultants and industry offer value training courses ranging from one day to 80 hours. Completion of one or more of these exercises is a positive factor, especially if it was a credit course or used formal examinations. The minimum requirement is successful completion of a Workshop Seminar of at least 40 hours and preferably 80 hours. This not only provides specialty education, but also simulates the actual work. He is then better able to decide upon it as a full time assignment.

Personnel may start their value engineering education on the job. This approach must be supplemented by outside reading and supervision. A workshop course should be taken at the first opportunity. On the job training of less than a year would benefit from formal classroom value training.

Sources. From the above criteria it can be seen that prior observation of candidates is best to make a good selection. A likely first source is the personnel at the installation. A selection from there will have knowledge of part or all of the operation and its major products. The substance of value engineering theory is more easily learned than the intricacies of the agency.

Value engineering Workshop Seminars are excellent sources of potential assignees. They offer an opportunity to see demonstrations of the attributes discussed above. Natural inclinations for value work will be manifested -- the selector need only observe critically.

Duties and Responsibilities.

The duties of value engineering personnel can be broadly divided into three categories: a) performance of value studies, b) implementation of

program task elements, and c) consultation or specialty assistance. Value engineering personnel are not solely responsible for the value of the organization's items. This burden lies upon all who make decisions which contribute to final cost.

Performance of Value Studies. This responsibility includes all elements of application of the theory to specific projects. It may be solo performance or as a member of a task force. This project may have been generated as the output of other efforts, such as cost targets, or their selection may be included in this activity. In either event, this category includes all efforts up to and including the recommendation of corrective action. It currently is the most common duty of value engineering personnel. It should not be delegated to any other organizational unit.

Implementation of Value Program Tasks. This category involves the value program elements which are delegated to other organizational units. Value engineering personnel responsibilities here include the efforts to: a) prepare the value engineering portion of the procedures, b) develop the technical capabilities necessary to implement the procedures, c) assist in their performance as requested, and d) monitor for adequate satisfaction of the value aspects.

Each organization needs to locate points of primary responsibility for these tasks. To a large extent these may initially be in the value engineering group itself. In these cases surveillance should be maintained to assure that efforts are not carried to the point of duplication or beyond the time for turnover to more logical areas of primary responsibility. Most of the tasks in this category will require value engineering assistance after turnover. Value training is an example of this group.

Consultation and Specialty Assistance. This area covers those efforts not associated with identified tasks. Briefly, it represents technical advice on the value engineering aspect of any current application by personnel at the installation. This situation occurs sporadically and cannot be scheduled. The individual involved: a) needs to recognize that he has a value problem, b) realize that he needs specialty assistance, and c) alert the value engineering organization for aid. Typical examples of this category include:

a) Consultation with equipment designers.

b) Evaluation of the value aspects of proposed changes.

c) Assessment of the value engineering portions of RFP's, proposals and subcontracts.

d) Surveys of supplier value programs.

e) Determination of the technical value engineering consequences of contract clause selection.

Career Development.

All of the aspects of career development for any career field apply to value engineering. Some salient features peculiar to this field may be briefly mentioned. These largely have to do with the nature of this work that causes it to be involved with so many other specialties and its relative youthfulness as a recognized career field.

Management recognizes that value engineering has been extended to only a fraction of its potential. Career development of the participating personnel will be required before this latent capacity can be fully realized. The subject can be examined from two viewpoints: a) development of the individual, and b) self-improvement.

Advanced Value Training. At the time of preparation of this Guide there was no formal program of value training which was beyond the material in the DoD Value Engineering Training Guides. Some value engineering R & D needs to be done before an advanced value curriculum will be feasible. Meanwhile, training in the areas with which value personnel have operating interfaces is useful. Education in the human factors aspects of value work is a logical part of career development. There should be advanced technical training in the theory or practice of the items handled. Finally, there may be portions of the daily work which need improvement, for example, technical writing.

Value engineering management needs to plan career development exercises for its people. These plans need to be reduced to practice and assessed for their effectiveness. It is unlikely, as past experience has demonstrated, that few personnel have all the knowledge they need to achieve maximum results from this theoretically simple, but otherwise complex, discipline.

Self-improvement. It is only a short while after starting a value engineering assignment before one realizes the lack of much needed knowledge. Action to reduce this lack is so incumbent upon value engineering personnel that this subject could have been discussed in the earlier section on Duties and Responsibilities. It was placed here in recognition of management's role to identify the most needed areas and to support corrective action. Many avenues are available for self-improvement. These need not be detailed in this Guide.

## ORGANIZATION

A designated value engineering organization is a fundamental element of a value program in the DoD and industry. The size, structure, level, and location of a value engineering group cannot be presently specified; they are dependent upon the installation served. Some guidelines will be provided concerning size and location. The structure will be discussed in terms of the coordination and operation duties of a value engineering group. An organizational approach will be suggested to most economically satisfy these duties. The management level that the value engineering group should report to can only be discussed in principle.

Each installation needs to evaluate its needs in terms of the following guidelines and the other data in this Guide to make its organizational decisions. The initial decisions made when the value program is installed should be re-assessed at periodic intervals of no greater than every six months for at least the first two years.

### Size.

The manloading depends upon the size of the facility served and the anticipated workload. The lower limit is one man full-time and may reach 10 to 15 people at installations that have sufficient personnel and products. The value engineering organization may require an inordinately large staff when the installation's value program is first installed. As the program gathers momentum, primary responsibility for some of the task elements is transferred to other groups. The value engineering staff should either decrease or shift their focus to operating tasks.

Structure.

An insight into the structure of a value engineering organization can be gained by considering two broad categories of its duties: a) coordination and b) operations. The using agency must evaluate its needs and make specific assignments of these categories to a selected number of personnel. Initially the responsibility for coordination and operations may be vested in one focal point. As the value program is reduced to practice it may be desirable to separate these functions. If this is done, the coordination function is a logical staff assignment and operations should be a line function.

Coordination Function. The coordination function includes program development, implementation, control, assessment and the support of those value engineering task elements assigned outside of the value engineering group. Some specific responsibilities common to industry and the DoD are:

a) Develop and participate in the internal value training or indoctrination program. If the facility has an internal training capability, the value engineering coordinator assists in the technical aspects of the value engineering training courses.

b) Develop and disseminate technical data (such as value standards, cost per function, and cost of standard machine operations) which will aid the operations personnel.

c) Review procurement requirements to determine which value engineering clause is technically most applicable to the specified requirements, contract type and acquisition phase.

d) Assess the effectiveness of the internal and contractor value engineering programs.

e) Maintain an interchange of technical and cost information with other functional groups such as reliability, maintainability, logistics, quality and production.

f) Review suggested projects for final selection and make study assignments to operations personnel or to task forces.

g) Coordinate the administration of contractor value engineering efforts if there are several simultaneous procurements with each having its own operational value personnel.

In industry the coordination function also prepares the value engineering portion of proposals and coordinates submissions to the DoD from the various operational elements.

Operations Function. The operations function of a value engineering organization has primary responsibility for certain value engineering program task elements and for maintaining a dynamic interface with other operational groups that affect end item value. Some of the specific duties in the DoD and industrial value operations are:

a) Perform those value engineering program task elements delegated by the installations value program plan, directives, regulations, specifications, and other regulatory documents. These will normally be the performance of value engineering studies, specification and design value reviews, and the generation of value engineering proposals which recommend a lower end item price.

b) Develop specific cost visibility data for the type of item or processes commonly handled.

c) Provide technical specialty support for other areas of the installation as required (usually performed by the coordinating function).

d) Administer contractor value engineering programs for specific procurements. This includes program plan review, report review, participation in training, and coordination of value engineering change proposal submission and processing.

Organizational Approach. The coordination and operational elements may be vested in one designated group. This group can be subdivided, formally or informally, to satisfy both sets of duties. When the operational tasks (especially the value studies) have a variable work load to support several projects under the installation's control, a centralized value engineering organizational structure may be optimum. Under this "pool" concept, the value engineering personnel are technically assigned to projects as required while administratively reporting to the central value engineering group.

The pool concept may provide optimum manpower utilization. The value personnel will gain increased familiarity with the installation's items of responsibility, procedures and overall value problems. Manpower peaks and valleys may be alleviated by the administrative ease of assignment changes from between projects according to their variable needs and in between for coordination function duties.

Level.

There is no minimum management level which a value engineering organization must hold in order to successfully perform its mission. If the two basic value functions are separated, the coordination function will

usually report to a higher management level than the operations function. The operations personnel could report directly to the coordination function which might be the designated value management focal point for the installation. If the operations function is distinct, it should be visible on the organization chart.

Location.

There are no constraints upon the location of the coordination function within the parent organization. Value engineering is within the current structure of the DoD Cost Reduction Program. Hence, a logical organizational location is for value engineering to be allied with the installation's cost reduction focal point.

If the operational function is separated, it normally would be associated with one of the technical elements. Specifically which one will depend upon the items usually handled. In no event should the organizational location tend to subordinate the value engineering efforts to previous primary responsibility. Care must also be exercised that placement will not restrict its application. For example, value engineering has not been completely effectively applied to the R & D programs of an installation when it has been organizationally assigned to the production division.

## PROGRAM CONTROL

Planning.

The achievement of maximum benefit from a value engineering program requires planning for installation, operation, and control. In industry this may be manifested by a value engineering program plan based upon the statement of work in the contract. In the DoD a plan is equally necessary. It may be derived from exhibits, specifications, directives and regulations. The program plan acts as a communication link between the contractor and the DoD and between the agency and higher authority. It conveys the depth of understanding by its specific task descriptions, manloading and schedule. It becomes the basis for pricing and subsequent measurement of the value program effectiveness.

A program plan should describe all aspects of the planned efforts and should contain the following information:

a) Appropriate reference should be made to regulatory or contractual documents which required its preparation.

b) The intent and specific objectives of the particular value engineering program must be delineated. It should have sufficient detail to permit other authorities to understand how these objectives are planned to be met and the expected results.

c) An organization chart should be included to convey a clear understanding of the value engineering group nomenclature, level and location with respect to the other organizational elements which it will deal with. These latter include engineering, fiscal or finance, procurement, logistics, and fabrication.

d) A detailed description of the task elements to be performed must be included. This portion of the program plan should reflect applicable required directives and the value engineering needs of the project or installation.

e) A program schedule is needed in milestone or other equivalent format which portrays the relationships between the tasks to be performed and the calendar or the overall project schedule.

The tasks presented in the program plan should represent suitable selections appropriate to the installation or to the procurement. They should be commensurate with the level of funding, manpower availability and the acquisition phase of the items that will be treated. If the level of effort does not permit implementation of all possible value tasks, the program plan should present the rationale for its selections.

The value engineering program plan should be critically re-examined at regular intervals (roughly every six months) in the light of achieved progress, expenditures and results. Revisions should be made when necessary to maintain the document as a program control parameter.

Motivation.

The DoD is promoting the concept of incentive contracting to stimulate contractors to greater economy and performance through increased profit. A "Value Engineering Incentive" clause is one aspect of this motivation. As discussed earlier, this has caused contractors to look to their individual employees as significant factors in profit achievement.

Within the DoD, regulations and directives have stressed the personal aspects of cost effective performance. These and other factors are effective to the extent that they are stressed and practiced.

It is a value engineering management responsibility to positively participate in the motivation of individual cost effective performance. Each such manager needs to develop a series of mechanisms to generate a "value climate" at his installation.

Information Services.

The subject of cost and cost reduction is currently receiving much attention. The incentive mode of contracting is stimulating, and even providing the contractor with assistance to reduce costs. New cost control techniques such as PERT/Cost, the weighted guidelines method of profit computation, computer applications to cost effectiveness studies, films, handbooks, manuals, directives, letters, and regulations have all been promulgated which speak in terms of reducing costs. Industry has responded with professional societies, studies, analyses and recommendations for better means of controlling and reducing costs.

These actions, coupled with the establishment of cost reduction quotas, have engendered an atmosphere prone to public announcements of positive responses. Industry and DoD representatives have prepared newsletters, press releases, exhibitions of success stories and articles.

None of this is harmful in itself; but, it must be pointed out that since value engineering is a cost reduction oriented discipline, it is heavily involved. Value engineering program management needs to recognize the applied pressures and react in a manner which will not cause subsequent disavowal of prematurely aimed results.

Positive control procedures must be instituted by value engineering program management for information release. These must, of course, be consistent with agency directives. A balance of information release needs to be maintained so that successful applications may be used in the motivation program previously mentioned. In all cases, extreme care should be exercised so that value engineering generated information reports or releases do not imply that the original designer (or his organization) was incompetent and do not imply more credit to a value engineering organization than it is due for its part in the cost reduction efforts of many.

## RESULTS

The objective of value engineering is the improvement of value by the reduction of cost. The results of value engineering efforts can be considered in three categories: a) mandatory, b) desirable and c) potential. Desirable and potential results may be either direct or indirect. Direct results are the achieved cost reductions which can be unambiguously measured. They frequently occur in other than cost units: a) improvements in reliability, b) improvements in ease of supply, and c) increases in the opportunity for competitive procurement. These other factors, although real, may be subordinated to claims of savings under severe cost reduction pressures.

A significant portion of value engineering achievements is gained through the efforts of personnel other than the designated value engineering personnel. Their value results are not always clearly visible nor immediately evident. Thus, they may be called indirect; this does not mean that they are not real. The application of value engineering to the early design phase has also produced results which are more easily and realistically measured in units other than dollars. There is, for example, an improvement in a company or DoD agency cost-consciousness atmosphere. This is a highly desirable result, since the lack of this climate is an environmental factor that has contributed to the need for this subject. Indirect benefits also result from increasing the capability of personnel to produce a more cost-effective item than they might have otherwise.

### Contractor Efforts.

Contractor, and some DoD, value engineering results can be most conveniently examined in light of the methods that the DoD uses to obtain them. The results of value engineering service contracts are derived directly from the statement of work and need no amplification here. However, the results of value engineering efforts obtained as an element of a larger procurement may be discussed. The DoD uses one of two types of clauses to seek these results.

"Value Engineering Incentive" Clause Results. The ASPR states that, "The objective of a value engineering incentive provision is to encourage the contractor to develop and submit to the Government cost reduction

proposals which involve changes in the contract specifications, purchase description or statement of work." It encourages the implementation of a value engineering program. It does not have any mandatory results. Nothing is required; nothing must be reported. Furthermore, the desired results can be obtained only if the clause is invoked. Desired and potential results of the direct and indirect types may be realized from application of the incentive clause.

Direct Results. The direct (and desired) results are proposals to change contractual requirements which will lower the contract price. The ASPR speaks of these as "cost reduction proposals" submitted pursuant to the clause. These are sometimes called VECP's when the contractor uses the Engineering Change Proposal (ECP) form based upon ANA Bulletin 445A for this purpose. Other nomenclature is used for proposals which either do not (or may not) use the ECP format. In any event, the submission of these proposals represents the contractor's results. Processing and disposition of these proposals are the DoD agency results. (Assessment includes evaluation of the contractor's results in the light of their disposition.)

These desired direct results can be quantitatively expressed in dollar units. They may be obtained from the contractor submittals and verified by the supplemental agreements which actually change the contract price. The Government share of the cost reduction is the DoD direct result. The Government's usage of the changes on other procurements is an additional potential result. This result is greater than the direct result because the Government does not have to share the cost reduction.

Indirect Results. The indirect results that are possible outputs of contractor value engineering efforts under incentive clause coverage are difficult to specify. They represent the capability improvements emanating from value training, value climate improvement and personal motivation factors.

The contractor may also produce change proposals which he may reduce to practice without the approval of contracting officer. These internal changes may represent immediate or potential results to the DoD. If these changes are made on an FPI or CPIF contract they will mean a lower final contract cost than if they had not been implemented. The Government result is its share of the resultant underrun, when it occurs. It needs to be

identified and verified if a positive result claim is to be made. (These results may be expressed as cost avoidances.)

If the contract is not an incentive type, these indirect results are seen as potential results by the DoD. They may be manifested as lower cost of future procurements from that contractor.

"Value Engineering Program Requirements" Clause Results. The ASPR clause states, that, "The contractor shall engage in a value engineering program, and submit progress reports thereon, as specified in the Schedule." Program requirements clause coverage will produce mandatory, desired and potential results.

Mandatory Results. The minimum mandatory results are the "engagement" in a value engineering program and the submission of reports. The Statement of Work, or other portion of the contract Schedule, may define additional mandatory results. For example, the submittal of a value engineering program plan has previously been suggested as a requirement. Additionally, program descriptions, specifications or exhibits may be incorporated which will require specific task performance. In any event, it should be noted that the mandatory result is task performance evidenced by document submittals, not cost reduction. These mandatory results are indirect. They can be expressed in terms of actions taken. It is extremely difficult to realistically convert these actions into equivalent dollar consequences.

There is one other category of mandatory result in these cases. The ASPR clause states that "... the contractor shall submit any cost reduction change proposals resulting from the required program." It is the submission of these rather than their generation that is mandatory. When submitted they can be viewed as direct results and treated in this respect similar to the previous discussion of the "Value Engineering Incentive" clause.

Desirable and Potential Results. These are indirect and are substantially the same as previously discussed under the incentive provision. However, they have a higher probability of being obtained in this case. This is because direct efforts are being performed to gain them. Additionally, the potential results are increased because the Government

obtains the right to use submitted data, including cost reduction proposals, even if they are not applied to the contract at hand.

DoD Efforts.

Value engineering application within DoD agencies also produces direct and indirect results. It is not pertinent to categorize these here as mandatory or nonmandatory. This is a command consideration of the mission assigned to the value engineering group. The significant point is that the results of DoD value efforts manifest themselves as larger benefits to the Government. No sharing of results occurs. All of the factors of identifying direct and indirect results previously discussed apply in-house. As also noted before, the DoD actions associated with the administration of contractor programs are identifiable results.

## ASSESSMENT

Assessment is used here to mean the appraisal of extant or completed value engineering efforts for effectiveness and control. It includes: a) audit, b) evaluation, and c) determination of corrective actions. Each of these three factors, but especially the audit, should reflect the consideration of results discussed previously.

Assessments may be made of contractor or DoD value programs. The installation's value engineering personnel should contribute to the audit procedure development and analysis of its results but probably should not actually conduct audits at its own location. Formal assessments should be performed annually.

Audit.

The audit is a fact finding exercise. An agenda appropriate to the installation or project to be audited should be prepared. It should seek facts supported by tangible evidence. The data sought should be of three types: a) what has been done, b) what has not been done, and c) what are the problem areas?

The audit must cover the value engineering operation as well as other organizational elements. The other groups are selected according to their responsibility for value engineering task element performance and for their disposition actions on value engineering change proposals.

Specific audit elements derive from consideration of the program to be evaluated. Some general facets that should be included are:

a) Does the organization chart show a value engineering activity and illustrate its relation to key functions such as procurement, engineering, fabrication, finance and project offices?

b) Do procedures and policies exist which delineate the value engineering program tasks, responsibilities and internal operation for the installation?

c) What is the record of applying value engineering projects as exemplified by memoranda, reports, or minutes of meetings?

d) What is the extent to which the program has received support as illustrated by management or command personal and written actions?

e) Do procedures exist and are they followed to assure the use of value engineering results on other programs or items?

f) Have informal assessments been made internally?

Evaluation.

Evaluation may be accomplished by a point rating approach. The agenda used for the audit could have an associated score for the answers to each question. Mandatory results should be weighted most heavily, then desired results and potential results should make the least individual contributions to total score. The resultant point score will be arbitrary but it will isolate corrective action needs. Subsequent audits may be compared for progress consideration.

Corrective Action.

This portion of the assessment derives from the evaluation with qualifications due to exposed problem areas. The entire assessment process is meaningful only if the corrective action needs are communicated to those responsible.

## SUMMARY: PROGRAM ADMINISTRATION AND MANAGEMENT

A. Contractor value engineering program efforts are overhead cost items on contracts with "Value Engineering Incentive" clauses and may be direct cost items on contracts with "Value Engineering Program Requirements" clauses.

B. The ASPR does not contain provisions for value engineering clauses in subcontracts.

C. Clauses proposed by prime contractors for use in their subcontracts need to be reviewed for compatibility with the prime contract incentive sharing provisions.

D. Personality traits which indicate a positive capability to react to the needs and problems of other personnel without arousing antagonism are the most significant selection criteria for value engineering personnel.

E. An installation should have a designated value engineering group. The exact organizational location and level of this group is dependent upon the size and type of facility, its products, policies, and its planned program.

F. Optimum operation of a value engineering program is assisted by initial planning of tasks, schedules, budgets and manloading. These must be periodically evaluated for comparison with actual occurrences.

G. The results of value engineering activities include: a) mandatory contractor results of value program operation from "Value Engineering Program Requirements" clause provision, and b) desired contractor results which include the submission of cost reduction proposals and achievement of internal cost avoidance by actions which do not require contractual implementation authority. Both of these may become potential results to the DoD for future procurements. Result of DoD actions include direct cost reductions accruing from approved contractor submittals, direct cost reductions accruing from in-house value studies and indirect present and potential results accruing from improving the cost determining personnel capabilities and climate for cost reduction.

H. Asseesments of DoD and contractor value engineering programs should be performed annually to audit, evaluate and recommend corrective action of the value engineering organization and all other elements which influence end item cost.

# CHAPTER 7: VALUE RESEARCH AND DEVELOPMENT

**A critical analysis of the value engineering discipline and some applications is presented... the need for improving certain areas is highlighted... some likely topics are offered as value engineering research studies... These include the management aspects of motivation... measurement... unification of several cost oriented disciplines... and improved directives... Other studies are suggested for some technical areas such as source data... Value Standards... Value Figures of Merit... Cost Visibility Standards... and value training improvement.**

# CHAPTER 7

# VALUE RESEARCH AND DEVELOPMENT

The management of any activity must consider its development to meet anticipated needs as well as its current application. Value engineering is not an exception. In fact it has been somewhat delinquent in this respect. This chapter will briefly, and critically, examine its current posture and suggest some possible avenues of exploration. It is a management responsibility to initiate these or other research studies to assure the value of value engineering in the changing pattern of DoD procurement and contract performance.

## STATE OF THE ART

### Theory.

The evaluation of function is the current manifestation of the value engineering theory. It is not very much different today than when it was originally developed over 15 years ago. It represents a qualitative rather than an exact, quantitative process. This is especially true of the worth values for functions. The current procedure relies upon the personnel's experience and judgment rather than upon scientific method. Its strength as an analytical tool could be greatly improved.

### Practice.

The value engineering task elements discussed earlier represent the present level of application practices. Some, especially training, have been practiced in the same manner for the past 15 years. The inclusion of value assurance training in this document and in the Principles and

Applications of Value Engineering Training Guide, is the first basic change in value education.

Some of the value program tasks are recent developments and have not had extensive tests in industry or in the DoD. They contain some decision elements based upon qualitative considerations and subjective application of experience and judgment. The Projects Requirements Evaluation isolation of poor value obligatory elements is an example. Another broad area of potential task improvement is the standardization of criteria and nomenclature for sub-elements of many value engineering program performance procedures.

## POTENTIAL AREAS OF DEVELOPMENT

The research and development of value engineering to improve its yield may be explored in three areas which are logical separations of the types of studies and the places, people or organizations that might perform them. Data needed for performance of some is more readily available in industry, some in the DoD and others could be performed by either. The research activities suggested in this Guide are by no means an exclusive listing.

### Management Aspects.

This area covers the aspects of accomplishments through personal contacts, procedures and regulations. For this subject it is the attainment of the objectives of value engineering, especially the long range objective of all cost determining personnel doing their own value engineering. Presently the application of value engineering is highly localized in the hands of value engineering personnel. Studies which culminate in better personal approaches, written procedures and personnel actions might dwell on these subjects:

a) Motivation, reward and correction strategies are needed. Their application would be to all personnel with respect to their use of the value engineering theory in daily job performance.

b) Measurement and assessment nomenclature and standards which quantitatively and realistically express cost reduction results are not adequate at present. These need to be in terms of impersonal benefit to the DoD, rather than to any one discipline such as value engineering. One organizational group might have performed

only a portion of the value effort but may receive inordinate acclaim because it has the same name as the theory or methods that were used.

c) A discipline should be developed that incorporates several presently co-existing elements that have similar high value objectives but use different nomenclature, procedures, and personnel. Some of these have extensive common interfaces, yet operate more or less independently. Typical possibilities are the value engineering, maintainability and reliability fields. A unified theory, similar to systems requirements analysis, that makes common use of the outputs of these three for example, would be a more powerful and efficient instrument than the sum of their separate actions.

d) Procedures and regulations are needed for a more realistic evaluation of value engineering change proposals for their effect upon future procurements and Government installation, operation and logistic costs.

Source Data.

Research studies in this area are needed to generate quantitative data for use in value engineering application. The need for these studies is to supplant the subjective generation of functional cost data with a more realistic basis derived from actual situations. Development of these data could become a basis for more quantitative contractual value engineering arrangements as well as a more realistic assessment of the total impact of proposed value engineering changes.

Value Standards. This nomenclature has been used loosely for some time. Published data, however, is virtually nonexistent. The term is used here to indicate dollar figures that represent reasonably achievable minimum costs for accomplishing specific functions. There is a finite number of possible functions. Standards of cost for achieving the most common ones would be a base for setting the worth or cost targets of items that represent the accomplishment of these functions.

Value Figures of Merit. This title is used to mean terms that express performance features in cost units. They express the variation, as improvement or degradation of performance, in terms of dollars. For example, an equipment reliability could be expressed in terms of the cost of achieving each additional 100 hours between failure as derived from mean time between failure (MTBF) consideration. Complications may be included to express other factors significant to a particular item such as cost in

dollars per unit of signal to noise ratio per 500 hours between failures. The cost consequences of reliability trade offs between alternative hardware designs would then be quantitatively expressed in dollar terms. This would provide increased cost visibility into the design decision process. Performance figures of merit without cost and cost figures of merit are in common use. But this use has generally been in analyses of systems economics, rather than for the unit end item level at which many costs are actually determined.

Cost Visibility Standards. Industrial consideration of the value of alternative approaches is frequently hampered by lack of knowledge of quantitative DoD cost data for the installation, operation and logistics of the items under development or production. This is especially significant in the case of studies which propose changes under value engineering incentive clause coverage. Knowledge of the preceding cost factors and the Government's cost of change processing should be criteria for contractor selection of study items and DoD change evaluation. Several situations have already occurred of DoD rejection of industry proposed value changes due to the cost factors not quantitatively available to the contractor. Parallel problems of inadequate using agency cost consequences could arise in the evaluation and implementation of DoD generated value changes.

Methodology.

Value engineering task performance procedures are susceptible to improvement. This includes those performed by value engineering personnel, and more significantly, those used by all cost determining personnel in their daily work routine. Some of this will be a by-product of the experiences gained as the performance task elements discussed in Chapter 3 are implemented more widely. Formal effort needs to be assigned to accumulate data, analyse and revise these task elements to take advantage of what is learned and to communicate it so that the same lessons need not be re-learned.

One example might be cited here. Value training has been widely practiced for over 10 years. The time required to accomplish the minimum effective presentation of Workshop Seminars is still virtually the same as it was 10 years ago. More efficient procedures would seem reasonably capable of development.

## VALUE RESEARCH AND DEVELOPMENT: SUMMARY

A. Value engineering needs development of certain of its methods, procedures and source data to allow a greater realization of its potential.

B. Research studies should be performed to make cost data available which would permit quantitative standards for determining the worth of functions, minimum costs of achieving functions, reasonable costs for performance parameters which include failure consequences and DoD usage cost figures for design and change decisions.

C. The results of current value engineering program task elements should be centrally collected and evaluated for task definition, procedure and application improvement.