resolution and contrast ratio of the original scene. A working definition of modulation transfer is:

$$MT = \frac{M_1}{M_o}$$

$$M = \frac{Bmax - Bmin}{Bmax + Bmin}$$

where

MT = modulation transfer
M_i = modulation of image
M_o = modulation of object
B = image or object luminance

What must still be determined is what values of MT are required for a given training objective.

In order to standardize the MT required for various training objectives and to standardize other combined parameters, studies involving optical, environmental, and human factors engineers must be performed. Programs are underway at NTDC to accomplish this goal. This approach should result in better defined specifications which take account of optical system limitations but provide the visual simulation characteristics necessary for efficient training.

PROFIT IMPROVEMENT THROUGH VALUE ENGINEERING

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Until about four years ago, when value engineering became a subject for contract negotiation, the difference between the general category of cost reduction and value engineering was considered academic at best. The fact that VE probed areas requiring Customer approval was thought "interesting," but as far as its profit impact, it was considered to be intuitively related to the cost reductions achieved. However, product costs were being reduced and the implied (if not measurable) impact on profit was enough to satisfy industrial requirements and justify the continuance of value engineering as an organized discipline.

Because of the somewhat unique aspect of VE—that of questioning the intended function of an item or system with respect to its cost—interest on the part of the Department of Defense started to grow. As Government began to probe this activity, Industry answered with a multitude of "before and after" examples, demonstrating how end-product costs can be reduced through the use of VE. The DOD soon realized that changes were being requested by Contractors which, when approved, measurably reduced the Contractor's cost to perform their contracts. The method most successfully employed to gain approval for VE proposals was referred to as "no-cost ECPs" (engineering change proposals), whereby a Contractor would request permission to modify an item under contract and indicate that the change would not increase the cost of the contract.

As value engineering expanded, the DOD decided to benefit directly from its results by requiring the identification of VE change proposals (VECPs) and reducing the contract price by the amount of the savings claimed. The effect was a marked decline in organized VE, for

in so doing, Government removed the incentive for investment in VE—profit improvement.

After a series of Government/Industry studies to motivate, regulate, and determine the most equitable method of rewarding contractors for their VE efforts, Defense Procurement Circular No. 11 (DPC #11) was released in October 1964. This document, as an advance to the ASPR (Sect. 1-1700) and followed by other DPCs, established the basic industrial incentive program for successfully performing VE. Although the regulations are administratively complex, they do represent a sound principle of equity which is based on a reward share of the savings realized, proportionate with the investment risk assumed by the Contractor in conducting a VE program. A Digest of the Value Engineering Incentive Provisions follows:

POLICY

It is Department of Defense policy that value engineering techniques shall be fully utilized by contractors. Major prime contractors are expected to encourage their subcontractors likewise to fully utilize VE techniques (1-1701).

Provisions which encourage or require value engineering shall be incorporated in all contracts of sufficient size and duration to offer reasonable likelihood for cost reduction (1-1701).

When the application of VE techniques discloses potential changes in contractual requirements that would reduce overall costs, contractors are encouraged to submit value engineering change proposals (VECPs) (1-1702.1). Certain explanatory information must accompany each VECP (1-1707.2(b) and 1-1708.1(b)).

To motivate contractors to submit VECPs, the Government will share with the contractor the savings resulting from accepted VECPs (1-1702.1). It is Department of Defense policy to be generous in sharing value engineering savings so long as they are definite cost reduction savings (1-1703.1(b)).

NEW FEATURES ADDED TO PREVIOUS ASPR COVERAGE

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

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

Encourages subcontractor VE programs and clarifies policy permitting prime contractor to count subcontractor's share of VE savings as part of cost to implement a VE change.

VALUE ENGINEERING CONTRACT PROVISIONS

Value engineering contract provisions are of two kinds:

1. Value engineering incentives, which provide for the contractor to share in cost reductions that ensue from change proposals he submits; and

2. Value engineering program requirements, which obligate the contractor to maintain value engineering efforts in accordance with an agreed program, and provide for the contractor to share in cost reductions ensuing from change proposals he submits. (1-1701).

TABLE 8

Specific Value Engineering Contract Provisions

	VE Incentive Clause (ASPR 1-1707)	VE Programs Requirement Clause (ASPR 1-1708)	Remarks
Required VE Effort	None required.	Level of required VE effort specified as a line item in contract Schedule. Specification MIL-V-38352 sets standards.	Both clauses contemplate contractor VE effort.
Subcontractor VE Effort	Major prime contractors expected to encourage their subcontractors to fully utilize VE techniques.	Same as incentive clause.	Subcontractor's costs of implementation and share of VE savings are recognized as part of prime contractor's cost to implement VECP.
Sharing	Contractor shares in VE savings.	Contractor shares in VE savings.	None.
Reports	None required.	Required as specified in the contract schedule.	None.
Cost Allowability (Negotiated Contracts)	Costs of normal VE effort are allowable per accepted accounting treatment (ASPR Section XV.)	Costs of performing the line item are allowable up to the amount specified in the contract. Costs of concurrent normal VE effort allowable per accepted accounting treatment (ASPR, Section XV).	None.
Responsibility for Accepting VECP	Contracting Officer.	Contracting Officer	None.
Data	Government normally obtains unlimited rights to data submitted with VECP when VECP is accepted.	Same as incentive clause.	None.

TYPES OF VALUE ENGINEERING SHARING ARRANGEMENTS
(See 1-1703.2, 1-1703.3, 1-1703.4)

1. Contractor shares in reduction in cost to perform instant contract.

2. Contractor shares in collateral savings in Government's cost of operation, maintenance logistic support, Government Furnished Property.

3. Contractor shares in future acquisition savings, based on follow-on procurements for one to three years after instant contract.

Methods of payment of contractor's share:

a. Lump-sum payment based on estimated future requirements when these requirements are firm.

b. "Royalty" payments based on actual future procurement when requirements are uncertain.

NOTE: The contracting officer must establish or negotiate the method of payment of the contractor's share of future acquisition savings prior to signing the contract.

4. The three types can be used singly or in combination, as appropriate.

TABLE 9

Contractor's Share of Net VE Savings in Cost of Performance of Current Contract by Type of Contract & VE Clause

	VE Incentive Clause (ASPR 1-1707)	VE Program Requirements Clause (ASPR 1-1708)	Remarks
FFP FPE	75% Maximum/50% Normal (See 1-1703. 5(b)(2)).	25% Maximum/25% Normal (See 1-1703. 5(c)(2)).	A share of less than 50% may be appropriate under the VE Incentive Clause if the contract is not awarded on the basis of adequate price competition. It may be appropriate to establish a smaller share for the prime contractor on VECPs originating with subcontractors than for those originating with the prime contractor. (See 1-1702. 5(e)).
FPI CPIF	50% Maximum (See 1-1703. 5(b)(2)	25% Maximum (See 1-1703. 5(c)(2)).	If costs and savings can be accurately estimated; if not, the share should be in accordance with the maximum overall cost incentive pattern of the contract.
CPFF	VE Incentive Clause is not to be included in CPFF (See 1-1702. 3(a)(t)).	10% Maximum/10% Normal (See 1-1703. 5 (c) (2)).	None.

CONTINUATION OF TABLE 9

	VE Incentive Clause (ASPR -1-1707)	VE Program Requirement Clause (ASPR 1-1708)	Remarks
Maximum Share	Same as share in savings in cost of performance of instant contract (See 1-1703. 5(b)(3)).	Same as share in savings in cost of performance of instant contract (See 1-1703. 5(c)(3)).	General: Contractor shares in future acquisition savings whether follow-on contract is awarded to him or to another contractor. This provision may not be appropriate in contracts involving several years of production of substantial quantities, such as multi-year procurements (See 1-1703. 2).
Normal Share	Significantly less than share in savings in cost in performance of instant contract. (See 1-1703. 5(b)(3)).	Significantly less than share in savings in cost of performance of instant contract (See 1-1703. 5(c)(3)).	Other things being equal, the longer the sharing period, which may range from 1 to 3 years, the lower the appropriate percentage share (See 1-1703. 5(b)(3)). (See 1-1703. 3(b) for criteria used to determine length of sharing period.)
FFP, FPE,	20% - 40%	10% - 20%	
FPR, FPI, CPIF	20% - 40%	10% - 20%	Provided costs and savings can be accurately estimated (See 1-1703. 5(c)(2)).
CPFF	Not applicable (See 1-1702. 3(a)(i)).	5%	

TABLE 10

Contractor's Share of Net VE Savings in Collateral Costs (Operation, Maintenance, Logistic Support, GFP)

FFP, FPE,	10% of savings accruing during one year's operational use of the item incorporating the VE change (See 1-1703. 5 (d)).	Same as VE Incentive Clause.	Contractor shares in net collateral savings even if acquisition cost of item increases, although any cost increase must be deducted from gross collateral savings prior to sharing net collateral savings.

CONTINUATION OF TABLE 10

	VE Incentive Clause (ASPR 1-1707)	VE Program Requirement Clause (ASPR 1-1708)	Remarks
CPFF	Not applicable (See 1-1702.3(a)(i)).	10%, as in CPIF	Head of Procuring Activity may omit this provision where he determines there is no reasonable potential for significant collateral savings (See 1-1703.4).

The term "reward" is not employed casually but used literally to describe the financial gains to the Contractor. As a reward, it is not considered profit at the time of performance and, therefore, excluded from the profit limitations associated with many Government contracts. However, in reporting to its stockholders, a company can show the results of an investment in VE through its P & L statement.

Another interesting facet of VE incentives is that by sharing the savings realized, VE is the only incentive arrangement that enters into a form of "partnership" with the Customer. Incentive contracts per se are not new or unique in recognizing outstanding accomplishments in quality, mission performance, delivery, as well as cost. However, VE is the only incentive arrangement that does not carry direct "profit penalties" for non-performance.

Considering the profit potential to Contractors who seriously pursue VE, how successful is this program? In FY 66, the DOD reported 50 million dollars saved through VE programs. Although this is an impressive accomplishment, it is relatively small when considering that the savings represent only .2% (approx) of more than 20 billion dollars in defense contracts released during that same period.

Many industrial and Government officials agree that a virtually untapped source of profits and cost reductions exists and that the VE incentive program should be an effective tool to uncover this mutual wealth. However, some problems exist, evident only to the performer, which prevent the conversion of potential economic gains to substantial cost effectivenesss.

Although the ASPR provides for VE program requirement clauses which allow the Contractor to charge directly to the contract for the administrative and study preparation expenses, the "permissive" contractual arrangement, in association with FP-type contracts, is by far the most often-used incentive approach. Under a permissive arrangement, the Contractor must assume the risk of "investing" in VE and hope that he can realize a favorable return on that investment through the acceptance and implementation of value proposals. This investment refers to financial expenditures associated with the search for lower cost alternates, internal technical reviews, preliminary qualification tests, models and study preparation. The proposal is then submitted and, assuming a positive response, reviewed by the contract and project authorities, configuration review boards, etc., with the Customer's cost to implement determined,and charged against the proposal. The net savings remaining on the contracts affected are then shared with the Submittor. It is this share received by the Contractor which determines whether the return was worth the investment. Should the response be less than positive, the proposal effort must be absorbed by the Contractor since it is considered a non-allowable, direct charge to the contract. To date, relatively few Contractors have found a receptive environment for the submittal of VECPs.

One element that is lacking is definitive Government procedures to be used by Customer representatives in determining how VECPs are to be administered and processed. Without such formal procedures coupled with the fact that it is not mandatory for a Contractor to

to perform VE (except for program requirement clauses), it is no surprise that Government representatives often attempt to avoid and even discourage active VE performance.

The Contractor is not entirely blameless in this situation. Many contract administrators, lacking a detailed knowledge of VE incentives and reacting to a negative response from their Government counterpart, will negotiate away the opportunity to actively pursue VE. Since it is rare to find a chief executive fully conversant on the subject of VE incentives, the loss of opportunity is not fully appreciated.

As of this date, value engineering does offer Contractors the opportunity to improve profits, not through related internal cost reduction activities, but by contractual agreement and regulated incentives. However, until Industry determined to aggressively pursue value engineering and the Customer develops a receptive environment at the working level, profit improvement through VE will continue to remain an "opportunity."

MULTIMISSION (FIGHTER/ATTACK) IMPACT ON FUTURE CREW TRAINING

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Today's aircraft weapon systems are primarily designed with a strong single-mission capability supplemented by limited multimission capability. It appears desirable, from a cost/effectiveness viewpoint, to develop a full multimission aircraft weapon system. Studies are being performed to determine requirements for such a system concept, its cost, and technical feasibility.

In support of these studies, Boeing, under Navy contract, is performing research concerned with training, cockpit, and avionics aspects of single-and two-place multimission fighter/attack aircraft weapon systems. The crew utilization program is being conducted in two phases, Figure 96.

Phase I, completed, was a preliminary analysis and development study for two multimission aircraft concepts—a single-place and a two-place aircraft with full fighter/attack capability. Study emphasis was on the cockpit, avionics subsystems, and flightcrew training.

Phase II, the flight simulation test phase, consists of three parts. Part A, recently completed, improved the Phase I concepts to a point where their use in a full multimission simulation test will provide required crew performance data. Part B, in progress, will provide test data on the single-place and two-place cockpit and avionics configurations operating under IFR conditions. Part C, to be completed May 1968, will provide test data on target acquisition under VFR conditions while performing realistic cockpit tasks.

This paper will present the results of the Phase II, Part A training analysis, and briefly summarize the simulator test programs and their feedback into an updated training analysis. The information is detailed in Boeing documents D6-60059-2, and -3, titled "Crew Utilization—Multimission Fighter/Attack Aircraft," dated March 1967.

The training analysis was performed to obtain projected estimates to answer the following questions:

Can flightcrews be trained for multimissions?