U.S. Department
of Transportation

**Federal Aviation
Administration**

Advisory Circular

Subject: USE OF VALUE ENGINEERING FOR ENGINEERING AND DESIGN OF AIRPORT GRANT PROJECTS

Date: 9/9/93
Initiated by: AAS-200

AC No: 150/5300-15
Change:

1. PURPOSE. This advisory circular (AC) provides guidance for the use of value engineering (VE) in airport projects funded under the Federal Aviation Administration's (FAA) Airport Grant Program. This AC should be used by sponsors of airport development projects considering the application of value engineering to projects involving grant funds.

2. APPLICATION. The guidelines contained herein are recommended by the FAA for use in the application of VE to the engineering and design of airport grant-in-aid projects. Standards for the application of VE to construction processes by the contractor are presented in AC 150/5370-10, Standards for Specifying Construction of Airports, General Provisions, Section 50, Cost Reduction Incentive.

3. BACKGROUND. Department of Transportation (DOT) Order 1395.1, Use of Value Engineering in the Department of Transportation, current edition, directs all administrations within the DOT to establish policies and assign responsibilities for the use of VE within its direct construction and grant programs.

a. Historic Use. VE was developed during World War II by industry as a means to continue production in the face of shortages of critical war material by substituting materials or systems that were available to accomplish the required task. The General Electric Company is generally credited with the development of the technique then known as ``Value Analysis." The U.S. Navy's Bureau of Ships in 1954 applied the concept to reduce costs during the design stage and called it ``Value Engineering." The Department of Defense (DOD) accepted VE as a practical means of obtaining the best practical value from its procurements and adopted VE in contract clauses under the Armed Forces Procurement Regulations (AFPR) in 1961, permitting contractor incentives in sharing VE contract cost reductions.

b. Current Use. Currently all of the DOD's operating agencies have adopted VE in their procurement programs, including construction, as have agencies of the DOT including the FAA, Federal Highway Administration (FHWA), and the Federal Transit Authority (FTA formerly UMTA). The FAA achieved life-cycle savings of $65 million on one construction project alone (airport cable loops/telecommunications), and the FTA reported life-cycle savings of $2.18 million on a bus maintenance facility. Other agencies have reported large life-cycle savings in construction programs, such as the Environmental Protection Agency (EPA) with life-cycle savings of $235 million over a 5-year period, the General Services Administration (GSA) which reported life-cycle savings of $43.4 million over the period 1972 to 1979, and the U.S. Army Corps of Engineers which reported life-cycle savings of $2 billion over the period 1964 to 1989. VE provides both the funding agency and the sponsor of a project with the opportunity and the means to not only improve the project but to substantially reduce costs.

4. RELATED READING MATERIAL. Additional information on value engineering may be found in the publications listed in Appendix 1, Related Reading Material.

5. FUNDAMENTALS OF VALUE ENGINEERING. The Federal Acquisition Regulations, Part 52.248, defines value engineering as an organized effort to analyze the functions of systems, equipment, facilities, services, and supplies for the purpose of achieving essential functions at the lowest life-cycle cost consistent with required performance, quality, and safety. VE is an important management tool for optimizing expenditures of funds for transportation facilities. Numerous government and private organizations have realized significant life-cycle savings since VE was first introduced, and although the techniques were developed for manufacturing and fabrication processes it has been equally applicable to the design of transportation facilities. Engineers have been doing this type of analysis as a matter of course in their work since engineering was developed. The difference is VE is an organized approach for a second look using a consistent set of concepts to optimize the difference between the cost of doing the construction and the cost of satisfying the user of the facility constructed. Reducing the scope of a project, or compromising the performance of an element, or simply substituting cheaper materials that will not function with the required reliability is not value engineering. The key feature of VE is the user-oriented approach. Reduced to it's simplest terms, it asks five basic questions:

a. What is it?

b. What does it do?

c. What does it cost?

d. What else will do the job?

e. What does that cost?

6. TIMING. VE, as it relates to the engineering and design of projects, is most effective when it is accomplished early in the design phase of the project. VE is most effective during these early stages because the ideas are still conceptual and the sponsor and the designer can be flexible with their decisions without incurring delays in the project schedule. The sponsor and designer should be examining their project budget at this point and performing a VE study can help them identify high cost elements before the final budget is decided. Once major decisions, those involving high cost items, are made the opportunity to influence final costs is greatly reduced. Value engineering studies for airport grant projects should be conducted at about the 30 percent completion point of design. Therefore, on federally assisted airport projects which are to be value engineered, the designer is required to submit a partially completed design at the 30% or 35% design completion stage. This partially completed design will be value engineered. There may be instances where value engineering at the 30% or 35% design stage is not appropriate. For example, construction phasing can have a significant impact on costs but not be determined until late in the design process. Permission to submit a partially completed design for value engineering at some other stage of completion requires approval from both the airport sponsor and the FAA.

7. ESSENTIAL CHARACTERISTICS OF VALUE ENGINEERING. VE has five characteristics that are essential to its success. First, VE relies on the use of many widely accepted analysis concepts and techniques. Second, VE is a systematic process and follows an eight-step job plan. Third, VE focuses on identifying and analyzing the function that the project component(s) or activity fulfills. Fourth, VE utilizes creative analysis techniques, especially ``brainstorming." Fifth, VE is performed by a team not associated in any way with the design team and draws upon the individual and collective viewpoints, experience, and knowledge of its members.

8. VE JOB PLAN. The systematic approach used in VE is called the VE Job Plan. It is an organized plan of action for completing a VE study and includes the implementation of recommended changes. There are eight elements or phases of the VE Job Plan:

a. Selection Phase. The objective of this phase is to select the project to be studied and assemble the VE team. This phase is one of the most difficult aspects of VE. Not every project requires a VE study. Some projects involve large sums of money but are relatively straight forward with little opportunity for alternatives. Other projects may involve expensive environmental commitments that may preclude value engineering judgments. Unusually large and/or complex projects are possible candidates for VE analysis. Complex projects might include one or more of the following features:

- Terminal buildings

- Security systems with many interactive devices and redundancies

- Bridges

- Large scale paving projects and/or those with complex drainage patterns and structures

- Foundation or embankment conditions requiring preconsolidation

- Large retaining walls

- Installation of lighting and NAVAID systems

Airport paving projects may or may not benefit from VE analysis, depending on the complexity of the project. There is a point of diminishing returns that will be reached when the cost to perform a VE study exceeds the overall life-cycle cost savings. It is imperative that the project characteristics that would require a VE study be determined at the outset. VE studies should only be undertaken when there is a good possibility of obtaining substantial life-cycle savings or improved design.

(1) Project Selection. In the selection of the project to be studied consideration should be given to the size of the project, the amount of life-cycle savings feasible, and the cost of the study. Commonly the most cost effective application of VE is against the highest cost components of a facility or project. Typically VE programs set a minimum target of three to five percent and often more for savings over and above the cost of the study. The decision to use VE and its application to a specific project should be discussed at the predesign conference.

(2) VE Team. A team consisting of five to seven persons usually produces the best results. The team should be structured so there is appropriate expertise to evaluate the major problem areas anticipated within the project, e.g., building components, lighting, foundations, soils, drainage, environment, etc.

b. Information Phase. The objectives of this phase are to gather pertinent information, analyze function and cost, and identify greatest opportunities for life-cycle savings. This approach breaks down the item to it's fundamental functions or purpose such as - what is it?, what does it do?, how much does it cost?. Data such as that relating to design criteria, plans and specifications, design restrictions, codes, standards, quantities, operations, and maintenance should be assembled. These are needed to familiarize the team on the project scope, establishment of constraints for function and cost evaluation, and to isolate the items of major costs.

c. Speculation Phase. The objective of this phase is to identify the maximum number of alternatives which will perform the intended function. This is sometimes referred to as the ``brainstorming phase.'' This phase identifies alternatives for evaluation, development, and refinement. It asks the question - What else will do the job and how much does it cost?

d. Evaluation Phase. The objective of this phase is to evaluate the suggested alternatives, eliminate unsuitable ideas, and select the most promising alternatives. This is a key element of the process, the determination of those ideas which will provide the required function(s) with the mandatory degree of reliability, safety, impact on operations, and other design criteria. Here the question of will it work is asked and the total costs are compared along with intangible factors.

e. Development Phase. The objective of this phase is to develop specific details about each promising alternative and prepare recommendations. A fully developed alternate is often called a value engineering proposal (VEP).

f. Recommendation and Approval Phase. The objectives of this phase are to recommend VEP's developed in the study and to obtain the approval of the sponsor for their inclusion in the final design. Prior to presenting the VEP's to the sponsor, the VE team must make recommendations to the original design team or the project management team. Recommendations should include the following: results of the function analysis, technical and cost data supporting the alternatives, problems and costs of implementation, and estimated life-cycle savings. At this point the most logical and feasible alternatives are selected by mutual agreement between the original design team and the VE team. The agreed upon alternatives are then recommended to the sponsor for final approval.

g. Implementation Phase. The objective of this phase is to put the accepted recommendations into practice. After the VEP has been approved by the sponsor, it is incorporated into the final design and construction schedule. The responsibility to incorporate and implement the change rests with the design team or the project management team. Action should be taken to ensure that it is fully coordinated and applied.

h. Audit Phase. The objective of this phase is to ensure that the desired results have been attained, documented, and reported. The results of the VE effort should be incorporated in the engineers' report showing what VEP's were adopted and the life-cycle savings associated with each VEP. Appendix 3 discusses the content and format of the Value Engineering Report. The report should be sent to the local FAA Airports District Office or Regional Office.

9. VE TEAM QUALIFICATIONS. The VE team should meet the following guidelines: a. Training. The VE team should have a diverse background with training in areas appropriate to the project being reviewed.

b. Experience. It is desirable, but not mandatory, that the VE team be experienced in Value Engineering.

c. Team Leader. The VE team leader should meet the training and certification standards for Certified Value Engineering Specialist (CVS), level II.

10. SHARING OF COST SAVINGS. No sharing of value engineering life-cycle savings will be permitted in contracts.

11. PROCUREMENT OF VE SERVICES. There are two methods available for procurement of VE services:

a. Contractor Resources-Specialty Firm. Where an organization or firm specializing in VE studies is contracted to conduct the study. The specialty firm and its personnel must meet the training and certification standards established by the Society of American Value Engineers (SAVE). Selection of a specialty firm to perform value engineering services should follow the procedures described in AC 150/5100-14, Architectural, Engineering, and Planning Consultant Services for Airport Grant Projects, current edition. Note that the primary design firm is excluded from performing the VE analysis.

b. Internal Resources (Force Account). The VE team is formed from personnel on the sponsor's staff. These personnel should meet the same training and certification standards as those established by SAVE and should provide the necessary cross-section of expertise for the particular project. The sponsor should certify to the FAA that the internal resources meet the required training and certification standards.

12. VALUE ENGINEERING CONTRACTUAL AGREEMENTS. Costs for VE services should be on the basis of a negotiated lump sum. The cost of a value engineering study is usually 0.2 to 0.4 percent of construction cost. The engineering agreement should also contain a provision for readvertising in the event agreement cannot be reached on the negotiated lump sum. Procurement policies for VE services for agencies of the Federal Government are set forth in Parts 48 and 52 of the Federal Acquisition Regulations (FAR). Excerpts of applicable portions of Parts 48 and 52 are presented in Appendix 2. Both of these may be used for guidance in developing clauses for inclusion in engineering agreements. Appendix 2 contains copies of portions of FAR Parts 48 and 52 that may be used for guidance in developing VE clauses in the contract.

13. SPONSOR FORCE ACCOUNT. The FAA requires that proposals to perform value engineering by force account be submitted in writing and that FAA approval be obtained prior to the start of any work. The proposal should include as a minimum:

a. Names and engineering qualifications of personnel performing the work and their capabilities for performing value engineering.

b. Details of experience with value engineering.

c. Information on workload as it may affect capacity to do the work within a required timeframe or work schedule.

d. Justification for doing the work by force account rather than by contract.

e. A complete cost breakdown showing (1) the number of work hours and cost per hour for each category of labor, (2) a list of nonsalary costs such as travel, materials, supplies, equipment, etc. A limit on the total cost should be specified in the proposal.

for
LEONARD E. MUDD
Director, Office of Airport Safety and Standards

APPENDIX 1 - RELATED READING MATERIAL

1. AC 150/5370-10, Standards for Specifying Construction of Airports, U.S. Department of Transportation, Federal Aviation Administration, Washington, DC.

2. AC 150/5100-14, Architectural, Engineering, and Planning Consultant Services for Airport Grant Projects, U.S. Department of Transportation, Federal Aviation Administration, Washington, DC.

3. AASHTO GUIDELINES FOR VALUE ENGINEERING 1987; American Association of State Highway and Transportation Officials, Washington, DC.

4. VALUE ENGINEERING BASICS; January 1985, Director of Value Engineering Training, Department of the Navy, Naval Material Command, Washington, DC.

5. MIL-STD-1771, VALUE ENGINEERING PROGRAM REQUIREMENTS; Department of Defense, Washington, DC.

6. A RECOMMENDATION REPORT FOR VALUE ENGINEERING; Broglio, D.J., and Wimes, A.C., February 21, 1991 ; Federal Aviation Administration, Washington, DC.

7. FHWA REPORT No. HI-88-048, GUIDELINES FOR VALUE ENGINEERING (VE); AASHTO-AG-ARTBA Task Force No. 19, February 1988, Federal Highway Administration, Washington, DC

8. UMTA Report No. DC-06-483-88-1, VALUE ENGINEERING PROCESS OVERVIEW, FINAL REPORT; January 1988, Lee Wan and Associates, Inc., Urban Mass Transit Administration, Washington, DC.

9. VALUE ENGINEERING: AN IDEA WHOSE TIME HAS COME, 1991 AASHTO VALUE ENGINEERING CONFERENCE; September 1991, American Association of State Highway and Transportation Officials, Washington, DC.

10. FHWA REPORT NO. TS-84-216, VALUE ENGINEERING CONTRACT PROVISIONS ON FEDERAL-AID HIGHWAY CONSTRUCTION PROJECTS; Johnson, E. and Rossman, B., December 1984, Federal Highway Administration, Washington, DC.

11. VALUE ENGINEERING FOR HIGHWAYS: THE ANALYSIS OF FUNCTION, COST, AND WORTH IN TRANSPORTATION DEVELOPMENT; Federal Highway Administration, 1983.

12. VALUE ENGINEERING IN THE CONSTRUCTION INDUSTRY; Dell'Isola, A., 1982, Van Nostrand Reinhold Company, Inc. N.Y.

13. VALUE ENGINEERING IN PRE-CONSTRUCTION AND CONSTRUCTION - NCHRP SYNTHESIS NO. 78; Turner,O.D., and Reark, R.T., National Cooperative Highway Research Program, Transportation Research Board, Washington, DC.

APPENDIX 2 - CODE OF FEDERAL REGULATIONS

EXCERPTS TO BE USED FOR GUIDANCE IN DEVELOPING CONTRACTS FOR VALUE ENGINEERING

1. CODE OF FEDERAL REGULATIONS, FEDERAL ACQUISITION REGULATION, PARTS 48 and 52, VALUE ENGINEERING. The following excerpts are reprinted from the Code of Federal Regulations, Federal Acquisition Regulation, Parts 48 and 52, Value Engineering. Dotted lines indicate where nonapplicable portions of the regulations were omitted.

PART 48 - VALUE ENGINEERING

Sec.

AUTHORITY: 40 U.S.C. 488(c); 10 U.S.C. Chapter 137; and 42 U.S.C. 2473(c).

SOURCE: 48 FR 42443, Sept 19, 1983, unless otherwise noted.

48.000 Scope of part.

This part prescribes policies and procedures for using and administering value engineering techniques in contracts.

Subpart 48.1 - Policies and Procedures
48.101 General.

(a) Value engineering is the formal technique by which contractors may (1) voluntarily suggest methods for performing more economically and share in any resulting savings or (2) be required to establish a program to identify and submit to the Government methods for performing more economically. Value engineering attempts to eliminate, without impairing essential functions or characteristics, anything that increases acquisition, operation, or support costs.

(b) There are two value engineering approaches:

....

(2) The second approach is a mandatory program in which the Government requires and pays for a specific value engineering program effort. The contractor must perform value engineering of the scope and level of effort required by the Government's program plan and included as a separately priced item of work in the contract Schedule. No value engineering (VE) sharing is permitted in architect-engineer contracts.

....

[48FR 42443, Sept. 19, 1983, as amended at 54 FR 5057, Jan. 31, 1989]

48.102 Policies

....

(h) In the case of contracts for architect-engineer services, the contract shall include a separately priced line item for mandatory value engineering of the scope and level of effort required in the statement of work. The objective is to ensure that value engineering effort is applied to specified areas of the contract that offer opportunities for significant savings to the Government. There shall be no sharing of value engineering savings in contracts for architect-engineer services.

....

[48 FR 42443, Sept. 19, 1983, as amended at 51 FR 2666, Jan. 17, 1986, 54 FR 5057, Jan. 31, 1989; 55 FR 3887, Feb 5, 1990]

....

Subpart 48.2 Contract Clauses

48.201 Clauses for supply or service contracts.

(f) Architect-engineering contracts. The contracting officer shall insert the clause at 52.248-2, Value Engineering - Architect-Engineer, in solicitations and contracts whenever the Government requires and pays for specific value engineering effort in architect-engineer contracts. The clause at 52.248-1, Value Engineering, shall not be used in solicitations and contracts for architect-engineer services.

[48 FR 42443, Se[t. 19, 1983, as amended at 54 FR 5057, Jan. 31, 1989; 55 FR 3887, Feb. 5, 1990]

....

52.248-2 Value engineering - architect-engineer.

As prescribed in 48.201(f), insert the following clause:

VALUE ENGINEERING - ARCHITECT-ENGINEER (Mar 1990)

(a) General. The Contractor shall (1) perform value engineering (VE) services and submit progress reports as specified in the Schedule; and (2) submit to the Contracting Officer any resulting value engineering proposals (VEP's). Value engineering activities shall be performed concurrently with, and without delay to, the schedule set forth in the contract. The services shall include VE evaluation and review and study of design documents immediately following completion of the 35 percent design stage or at such stages as the Contracting Officer may direct. Each separately priced line item for VE services shall define specifically the scope of work to be accomplished and may include VE studies of items other than design documents. The Contractor shall be paid as the contract specifies for this effort, but shall not share in savings which may result from acceptance and use of VEP's by the Government.

(b) Definitions. Life-cycle cost as used in this clause, is the sum of all costs over the useful life of a building, system or product. It includes the cost of design, construction, acquisition, operation, maintenance, and salvage (resale) value, if any.

Value engineering, as used in this clause, means an organized effort to analyze the functions of systems, equipment, facilities, services, and supplies for the purpose of achieving the essential functions at the lowest life-cycle cost consistent with required performance, reliability, quality, and safety.

Value engineering proposal, as used in this clause, means, in connection with an A-E contract, a change proposal developed by employees of the Federal Government or contractor value engineering personnel under contract to an agency to provide value engineering services for the contract or program.

(c) Submissions. After award of an architect-engineering contract the contractor shall-

(1) Provide the Government with a fee breakdown schedule for VE services (such as criteria review, task team review, and bid package review) included in the contract schedule;

(2) Submit, for approval by the Contracting Officer, a list of team members and their respective resumes representing the engineering disciplines required to complete the study effort, and evidence of the team leader's

qualifications and engineering discipline. Subsequent changes or substitutions to the approved VE team shall be submitted in writing to the Contracting Officer for approval; and

(3) The team leader shall be responsible for prestudy work assembly and shall edit, reproduce, and sign the final report for each VEP. All VEP's even if submitted earlier as an individual submission, shall be contained in the final report.

(d) VEP preparation. As a minimum, the contractor shall include the following information in each VEP:

(1) A description of the difference between the existing and proposed design, the comparative advantage and disadvantages of each, a justification when an item's function is being altered, the effect of the change on system or facility performance, and any pertinent objective test data.

(2) A list and analysis of design criteria or specifications that must be changed if the VEP is accepted.

(3) A separate detailed estimate of the impact on project cost of each VEP, if accepted and implemented by the Government.

(4) A description and estimate of costs the Government may incur in implementing the VEP, such as design change cost and test and evaluation cost.

(5) A prediction of any effects the proposed change may have on life cycle cost.

(6) The effect the VEP will have on design or construction schedules.

(e) VEP acceptance. Approved VEP's shall be implemented by bilateral modification to this contract.

(End of clause)

[55 FR 3889, Feb. 5, 1990]

APPENDIX 3_VALUE ENGINEERING REPORT SUGGESTED FORMAT

This Appendix offers a suggested format for Value Engineering Reports to be completed on airport development projects with Airport Improvement Program assistance.

SAMPLE COVER PAGE

VALUE ENGINEERING TEAM STUDY

Project:
Location:
AIP Number:

FAA Region:
FAA Airport District Office:

VALUE ENGINEERING FIRM NAME:
ADDRESS:

PHONE:

VALUE ENGINEERING TEAM LEADER:
PHONE:

VALUE ENGINEERING TEAM MEMBERS

NAME	DISCIPLINE
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

SUGGESTED TABLE OF CONTENTS

PROJECT TITLE:
PROJECT LOCATION:
AIP PROJECT NUMBER:

VALUE ENGINEERING EXECUTIVE SUMMARY

AIRPORT:
AIP PROJECT NUMBER:
LOCATION:
VE REPORT DATE:
FAA REGION/DISTRICT

BRIEF PROJECT DESCRIPTION:

DESIGNER:
ADDRESS:

- -

EST. COST AT TENTATIVE ALLOCATION____

EST. COST AT TIME OF VE____

- -

VALUE ENGINEERING COSTS AND BENEFITS

TEAM STUDY COST: ____
TRAVEL COST:____
TOTAL VE COST:____

REPORTED SAVINGS:____

REDESIGN COST:____
ADMIN. COST____

ACTUAL SAVINGS:____

BENEFIT/COST RATIO = ACTUAL SAVINGS/TOTAL VE COST:_____________________

``S A M P L E''

VALUE ENGINEERING TEAM STUDY

SUMMARY OF VE RECOMMENDATIONS

PROJECT:
AIP PROJECT NUMBER:
LOCATION:

PROJECT:
AIP PROJECT NUMBER:
LOCATION:

VEP NUMBER	RECOMMENDATION	POTENTIAL SAVINGS
C-1	Brief Narrative	
C-2	Brief Narrative	
C-3	Brief Narrative	
C-4	Brief Narrative	
C-5	Brief Narrative	
Continue as Needed	Brief Narrative	

VALUE ENGINEERING PROPOSAL (VEP)

PROPOSAL NUMBER:

PAGE NO:_____of_____

MODIFICATION OF STANDARDS REQUIRED: No____ Yes____
If yes, what standard

ORIGINAL DESIGN:

PROPOSED CHANGE:

COST SUMMARY

ORIGINAL DESIGN	PROPOSED CHANGE SAVINGS	INITIAL COST	LIFE-CYCLE COST

One Page for each VEP