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LOCKHEED MARTIN

Environmental Restoration Value Engineering Guidance Document

MANAGED BY
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FOR THE UNITED STATES
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DISCLAIMER

Environmental Restoration
Value Engineering Guidance Document

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LOCKHEED MARTIN ENERGY SYSTEMS, INC.
managing the
Environmental Management activities at

Oak Ridge K-25 Site
Oak Ridge Y-12 Plant
Paducah Gaseous Diffusion Plant
Portsmouth Gaseous Diffusion Plant

Oak Ridge National Laboratory
under contract DE-AC05-84OR21400
for the
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PREFACE

This document provides guidance on Value Engineering (VE). VE is an organized team effort led by a person trained in the methodology to analyze the functions of projects, systems, equipment, facilities, services, and processes for achieving the essential functions at the lowest life cycle cost while maintaining required performance, reliability, availability, quality, and safety. VE has proven to be a superior tool to improve up-front project planning, cut costs, and create a better value for each dollar spent.

This document forms the basis for the Environmental Restoration VE Program, describes the VE process, and provides recommendations on when it can be most useful on ER projects. It was prepared under Activity Data Sheet 8303, Contract Management Support, Work Breakdown Structure element number 1.4.12.2.3, Program Management Support.

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ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Energy Systems	Lockheed Martin Energy Systems
ER	Environmental Restoration
FAST	Function Analysis System Technique
RCRA	Resource Conservation and Recovery Act
VE	Value Engineering

1. INTRODUCTION

Value engineering (VE), a term synonymous with value analysis and value management, is an organized team effort led by a person trained in the methodology to analyze the functions of projects, systems, equipment, facilities, services, and processes for achieving the essential functions at the lowest life cycle cost while maintaining required performance, reliability, availability, quality, and safety.

The purpose of this document is to provide guidance on VE. This document forms the basis for the Environmental Restoration (ER) Program VE Program. It describes the VE process and provides recommendations on when it can be most useful on ER projects. For various reasons, VE has become misunderstood and consequently under used. Some myths about VE dispelled in this document include:

- *Myth*: VE is for construction projects only.
- *Reality*: VE can be used on any project *or process*.
- *Myth*: The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) feasibility is equivalent to VE.
- *Reality*: Feasibility studies lack function analysis, the cornerstone of VE, and are performed late in the project life cycle, whereas VE can be used to get projects started right.
- *Myth*: The VE process is not suitable for administrative systems.
- *Reality*: The VE process works equally well for administrative systems.
- *Myth*: VE is just another management initiative.
- *Reality*: VE is a methodology; it has been around for fifty years.

This document is provided for those who feel overwhelmed and frustrated with the complexities of ER project management and are willing to try a well-proven tool. Although historically VE has been under used by the Department of Energy, it has been extremely well used by the United States industrial competitors, who have integrated VE into the fabric of their business practices. Since VE has helped world-class competitors such as Toshiba and Toyota, properly implemented, it will help ER. VE requires a change from business as usual—it requires management vision and initiative to challenge the old ways of project planning and re-engineer those old processes to incorporate the VE methodology.

1.1 OBJECTIVE

The ultimate goal of the Lockheed Martin Energy Systems (Energy Systems) ER VE Program is to be nationally recognized as the premier contractor in the complex for superior project definition, cost savings, and schedule reduction. This will be accomplished by institutionalizing superior project management practices that incorporate the VE methodology to produce optimal value for our customers.

1.2 WHY VE?

As indicated by the Principal Deputy Assistant Secretary for Environmental Management, Richard J. Guimond, in his letter dated February 2, 1995, ER projects, when compared to similar projects in the private and public sectors, took longer to complete and cost more. Poor project definition was identified

as a major contributor to this lackluster performance. Because of this information and an ensuing stand down meeting of senior managers, the "Environmental Management Project Manager's Handbook for Improved Project Definition" was created to help remedy this situation. A prominent and primary tool endorsed and explained in that handbook is VE.

The methodology can be used to improve and/or plan many things, both physical (hard) systems and administrative (soft) systems. The duration of VE studies typically varies from one to five days and can be longer for large, complex projects. The minimum return on investment for VE analyses is 1000%. This means that a $20,000 VE analysis typically will identify $200,000 or more in cost savings, assuming a project of sufficient size. Usually the savings are much greater.

1.3 VE REQUIREMENTS

The three primary sources that require a VE program and VE studies are Office and Management and Budget Circular A-131, "Value Engineering;" DOE Order 4010.1, "Value Engineering;" and Internal Policy GP-26, "Value Engineering Program." However, VE should be used because it makes good business sense (as evidenced by the Japanese VE programs) and will help project teams—not simply because it is required. Today many United States government entities, such as the Environmental Protection Agency, Army, and Navy, require selected contractors to do VE studies on large projects. In addition, a bill (H.R. 719) entitled the "Systematic Application of Value Engineering Act of 1995," was introduced in the House of Representatives earlier this year that if enacted will require a VE program to be put in place for all government-funded work. The pressure is increasing to force government to add more value to its services and products.

Those managers who use VE on their projects will reap benefits as described below—those who don't will find that their program and projects will encounter more cost and schedule overruns, will have more scope changes, and will be forced to submit additional baseline change proposals. The differences between a project that has undergone a VE analysis and one that has not will be readily apparent to internal management, the Department of Energy Oak Ridge Operations Office, the regulators, and the public.

Individual ER program and project managers have the authority to decide when, how, and on what projects to conduct VE analyses. They may consult with the ER VE program manager for assistance in determining the expected value added by conducting a study on a case by case basis.

Program and project managers shall document their verified cost savings by project and report them to the ER VE program manager by October 1 of each year. These figures will be aggregated into a concise report for management that will describe the number of VE studies performed by site and the resultant savings. This report will be used to publicize the hard work and significant accomplishments of the ER organization.

1.4 BENEFITS OF USING VE ON ER WORK

VE is one more tool to help ER project managers be successful. Proper use of it can produce the following benefits:

Overall management benefits

- Understand and satisfy the customer's needs and expectations.
- Reduce project costs and shorten project schedules.
- Reduce unwelcome surprises.
- Build a cooperative project team and improve communication.
- Achieve success on projects.
- Establish a historical record documenting the bases for decisions made. This can prove vital later in the project life-cycle.

Problem definition benefits

- Ensure that the "right" problem is defined correctly at the start.
- Assure the public that our normal business practices include techniques that optimize project definitions so that the best solution has been chosen that creates sufficient value for the taxpayers.

Project controls benefits

- Reduce the number and size of baseline change proposals.
- Eliminate cost and schedule overruns.

Health and safety benefits

- Minimize risk and safety hazards.

A VE analysis can be targeted at a particular component of a project. For example, the analysis can be focused solely on accelerating the schedule, on reducing the complexity of the scope or optimizing a design, or simply creating more value for the funds used by doing all of these things.

1.5 WHO USES VE?

The private sector is perhaps the greatest user of VE. Japanese-based companies, who today maintain a $65 billion trade surplus with the United States, make extensive use of VE. Almost every Japanese engineer is trained in the VE process. The Japanese valued the work of Larry D. Miles (the originator of VE) so much that they awarded him the High Order of Imperial Medal for his contribution to Japanese industry and their economy. Only two other Americans have received this award: W. Edwards Deming and Lillian Gilbreath.

1.6 WHEN TO USE VE ON ER WORK

The section below describes the types of work included in ER and offers guidance on when a VE analysis may be of greatest benefit.

There are five general types of activities in ER:

- remedial action projects, consisting of assessment and cleanup of contaminated sites;
- decontamination and decommissioning projects, consisting of assessment and cleanup of surplus contaminated facilities;
- program management support, consisting of non-project-specific management and technical support, including technical integration activities;
- surveillance and maintenance, consisting of monitoring and maintaining ER sites and facilities until cleanup has been completed and the site or facility has been transferred to another custodian; and
- waste treatment, storage, and disposal projects.

For remedial action and decontamination and decommissioning projects, there are typically four optimal times to perform a VE analysis, as shown in Fig. 1.

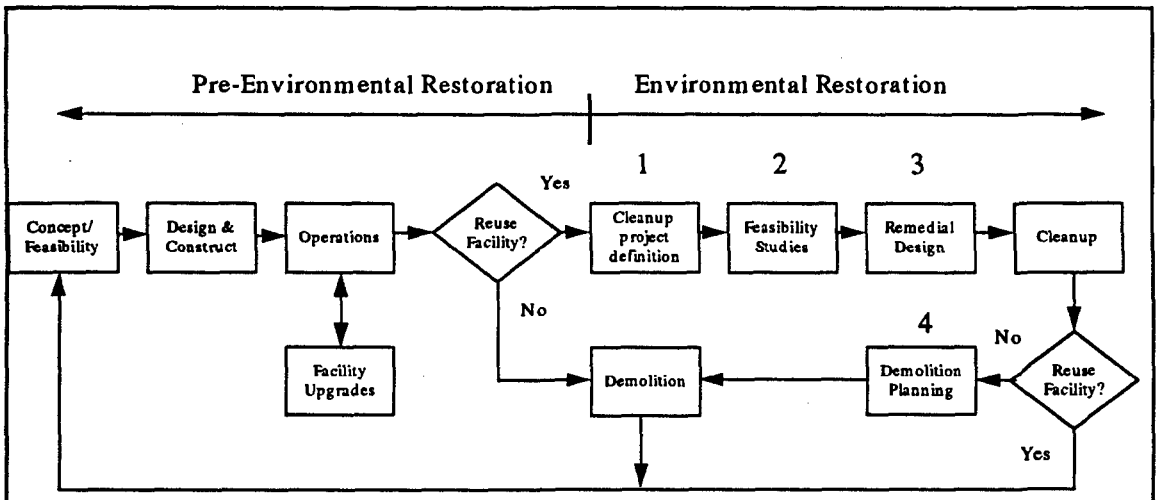

Fig. 1. Optimum times for performing ER VE studies.

The best time to use VE is at the project definition step. Doing so at this point can assure proper definition of *the right project*. Poor definition of "the project" or problem can lead to spending hundreds of thousands or millions of dollars only to have the project rejected by the DOE customer, the public, or both. Poor definition of the project also ensures that the project team will struggle with scope changes, will have to process many baseline change proposals, will have to report major performance variances,

and will be overworked and frustrated. The best schedules and cost estimates and reporting systems will not compensate for a project with an improperly defined scope. Note that in most every case the focus of an analysis conducted at this early phase will not be to cut costs (little or no cost data may even exist, and certainly no design data will exist). The focus should be on defining, using function analysis, the project objective(s) and required functions.

The second best time to apply VE is during the feasibility study (or equivalent) to select a preferred cleanup alternative. VE can improve the standard CERCLA or Resource Conservation and Recovery Act (RCRA) feasibility study since they do not include function analysis, the cornerstone of VE. The focus of a VE analysis conducted at this stage can include cost reduction, schedule enhancement, and scope definition.

The third best time is during the remedial design. Every design can be improved, and VE's track record on cutting the cost *and improving the quality of designs* is exceptional. Conditions change over time, requirements and needs change, and other things happen that influence the design that was originally selected. Typically, the focus of a VE study conducted at this stage is design optimization to ensure the highest quality for the lowest cost. Schedule acceleration may also be an objective.

The fourth best time, for applicable projects, is during demolition planning. For incentive-type projects, VE is an excellent tool to ensure that the right incentive project is identified and that when executed, the actual costs, schedule, and technical performance are all acceptable. The focus here is similar to that for VE analyses conducted at the feasibility phase, discussed above.

For program management support-related projects, VE may be used to help streamline and simplify existing management control systems and may also be used to help define tools to implement those systems, such as computer information systems. VE also can be used to look at entire organizations, divisions, and corporations as a whole.

For surveillance and maintenance–related projects, VE may be used to help define a streamlined, high quality, low cost approach to maintaining inactive facilities.

For waste treatment, storage, and disposal projects, VE may be used to initially plan these projects. It may be used during related feasibility studies (or equivalent), and it may be used during the preparation of needed designs.

As a rule, the earlier a VE analysis is performed on a project or process the greater the benefit. Another recommendation is to conduct a VE analysis before any decision that will commit the project to large expenditures of resources (e.g., feasibility studies, designs). Figure 2 below displays the relative benefits of conducting an analysis early versus late in the project life cycle. Note that the earlier an analysis is done, the greater the potential benefits to the project. Conversely, there is little if any benefit if a VE analysis is performed at the end of the project.

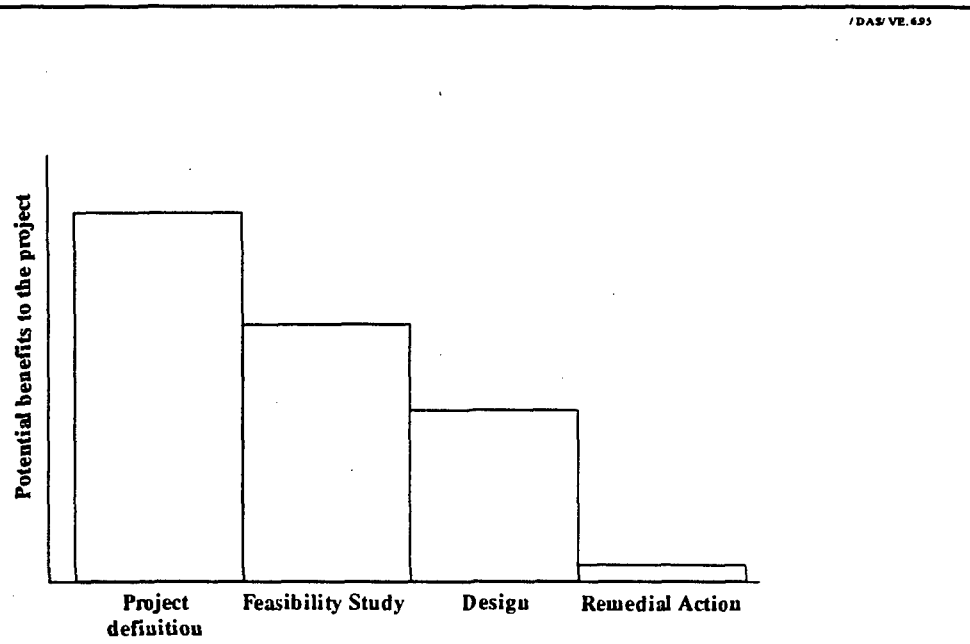

Fig. 2. Potential benefits of a VE study versus project phase.

2. VE METHODOLOGY OVERVIEW

The following sections provide an overview of the VE methodology. Important terms are defined and relationships are identified, a discussion of function analysis is presented, and VE is compared to management initiatives and a typical CERCLA feasibility study.

2.1 IMPORTANT TERMS AND RELATIONSHIPS

The following important terms and relationships help define and explain the VE process.

- Value — The most cost-effective way to reliably accomplish a function that will meet the quality and performance expectations of the customer.
- Function — That which a project or operations component must do to work and satisfy the customer.
- Quality — Conformance to specifications that results in a product that meets the customer's expectations.
- Reliability — Continuing to meet the customer's expectations for the product's intended life.
- Product — The result of our work.
- Customer — Everyone who receives our product.
- Worth — The lowest-cost method for satisfactorily performing a function.

2.2 FUNCTION ANALYSIS

Function analysis is a systems methodology that defines customer needs (using sequestered multidisciplined teams) in terms of the precise functions that satisfy those needs. Customers want functions, not structures, systems, and components. Functions express what is required (e.g., release site, report performance, prevent discharge, etc.) without specifying the solutions or technologies that we intend to use. In VE, the solutions are identified only after identification of the functions. This structured approach has a proven track record of consistently leading to innovative, creative, and cost-effective solutions.

People often decide on a solution to a problem without using a systems methodology—they simply make a quick decision. Sometimes, such quick decision making is essential and helpful. In other cases, such as with a potentially costly or highly visible cleanup project, a formal systems methodology using function analysis is the best way to reach acceptable, defensible, cost effective, and lasting decisions. Function analysis is an extremely important step in VE because it identifies and eliminates unnecessary or redundant functions—and every function consumes resources (money, time, etc.). By first eliminating unneeded functions, one may eliminate the cost of all measures that would have been taken to satisfy that function. Function analysis is thus a top-down systems methodology that leads team members to the minimal set of functions that must be satisfied to adequately address a customer's needs. A VE analysis can be done properly only if function analysis is used.

Function analysis consists of three steps: (1) determine project objectives; (2) list project functions; and (3) create a Function Analysis System Technique (FAST) diagram. Figure 3 shows a generic FAST diagram. Figure 4 shows a FAST diagram for a hypothetical remedial action project. For the ensuing discussion, reference to these two figures is beneficial to understanding the FAST approach.

The vertical dotted lines are used to limit the scope of the analysis. The function to the far right (outside the right scope line) is the causative function. This is the source of the problem under study. A typical example causative function for remedial action projects is "Contaminated Site." The function to the far left (outside the left scope line) is the higher order function. The higher order function is the ultimate goal of the analysis. A typical example of a higher order function for remedial action projects is "Release Site." To the immediate right of the higher order function is the basic function. The basic function is determined by asking (using the remedial action project as an example), "How do we release the site?" The answer to this may be a function such as "Restore Site." This process of asking "How?" is continued until all the functions required to satisfy the higher order function are identified. The list of functions from the higher order function to the causative function establishes the critical path functions.

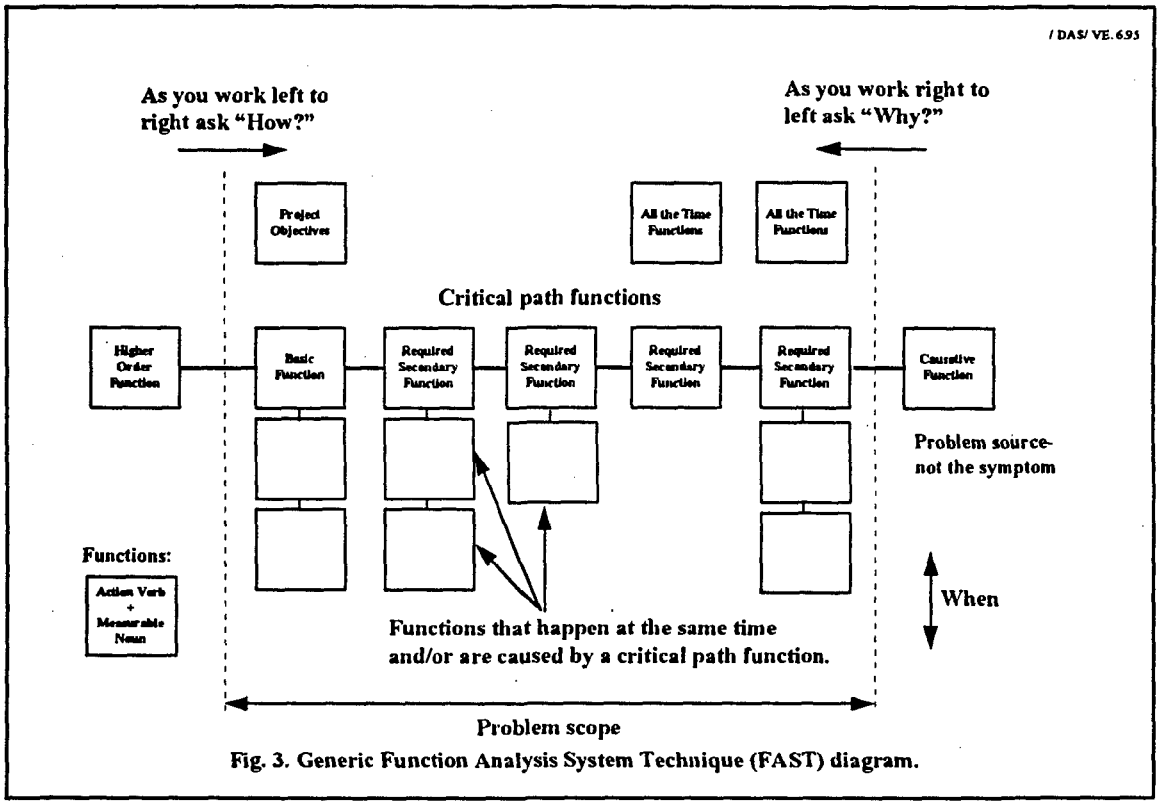

Fig. 3. Generic Function Analysis System Technique (FAST) diagram.

As a completeness check, adjacent functions should be tested with the "How-Why?" question to ensure that they are needed and that they are logical. As an example, "Why do we Excavate Soil?"...to "Remove Contamination."

Supporting functions are next added to the FAST diagram. This set consists of three groups. The first group is known as all the time functions. These are added to the upper right part of the FAST diagram. These functions must be satisfied continuously. Examples of all the time functions include "Protect Workers," "Maintain Access," and "Monitor Environment." The second group consists of additional objectives. These are added to the upper left part of the FAST diagram. These may include such things as "Decrease Cost," "Increase Maintainability," and "Increase Throughput." The last group of functions that are added are concurrent functions. These are added immediately below functions that they support. These functions happen at the same time. As an example, for a critical path function such as "Remove Contamination," several concurrent functions are necessary, such as "Dewater Soil," "Treat Water," and "Store Contaminated Soil." Another way of reading this is to say that *when* we "Remove Contamination" we "Dewater Soil," "Treat Water," and "Store Contaminated Soil." Each of these concurrent functions is shown directly under the function it supports.

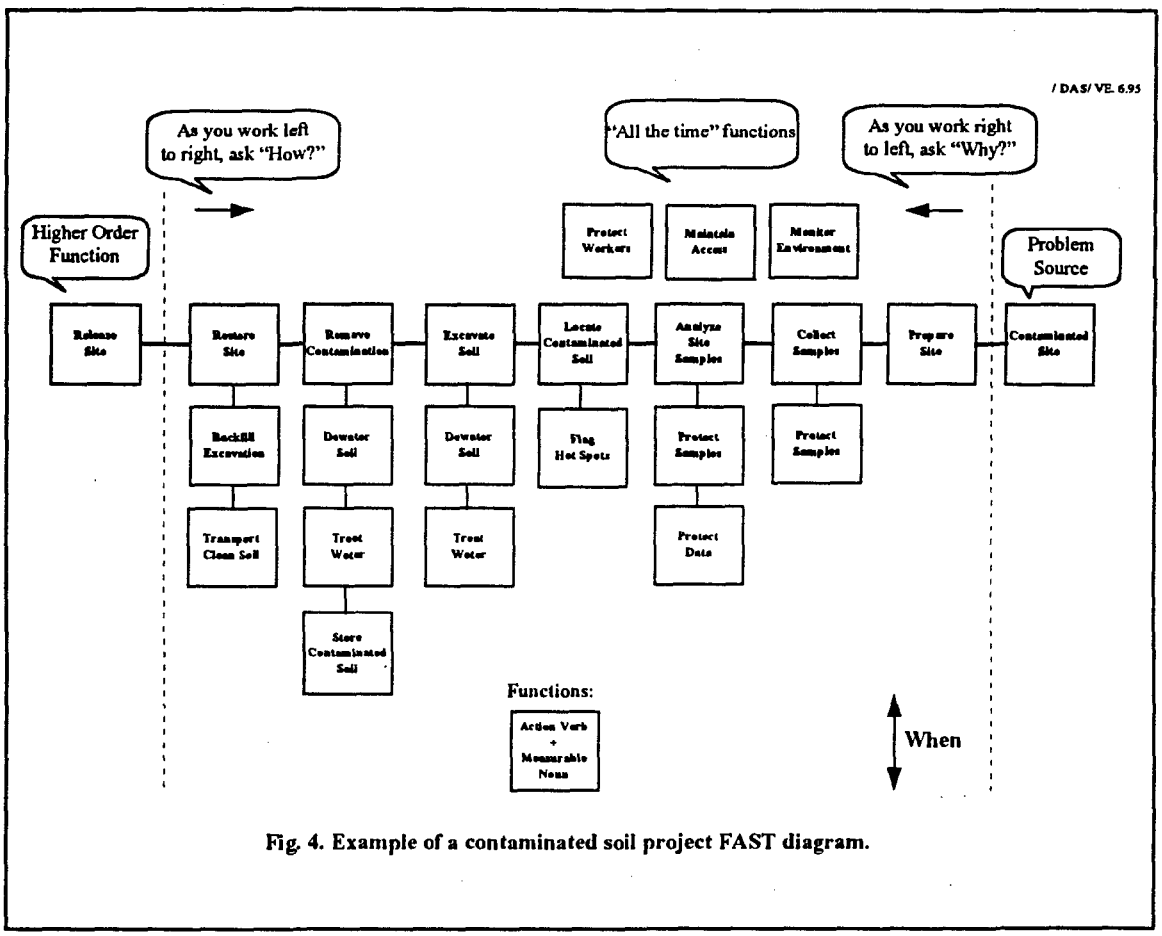

Fig. 4. Example of a contaminated soil project FAST diagram.

Functions should be defined with as few words as possible, preferably two—a combination of an action verb and a measurable noun. The more concise the function description, the better the probability that novel, unconstrained solutions to satisfy the function will be identified. Distilling a function to a couple of words requires discipline and mental agility. *A goal of the function analysis process is to decouple and dissociate the function from specific solutions.* This dissociation will lead to creativity and innovative solutions. An easily understood and humorous example of this is the difference between the functions "Cut Grass," and "Mow Grass." The first function purposely implies no specific cutting method. The second function is inferior since it presupposes the solution (mowing). The inventor of the WeedEater® used function analysis to rethink and fundamentally question what is desired and how else might that function be satisfied, such as using a fast spinning plastic line instead of a steel blade to cut grass. American lawns have not been the same since. An example of function analysis applied at the corporate level is that of Federal Express. When asked to define what is essentially the higher order function for Federal Express as a whole, the Chief Executive Officer commented, "Sell Time." Customers use FedEx because they need more time. Every activity in the company works to serve this higher order function. Function analysis can be applied equally well to defining organizations that work better or for re-engineering existing ones.

The net result of a FAST diagraming exercise is that it enables a project team to achieve consensus on what the project is and what is required to successfully complete it. A key benefit of the FAST exercise is that it forces a team to fundamentally question the problem and forces them to rigorously define the functions required to solve the problem. This ensures that subsequent work by the team has a greater potential to be successful. The FAST diagraming approach makes innovation and creative problem solving much easier. To be successful, though, all team members must actively participate during the FAST diagraming process.

Sometimes it will not be possible to come to agreement on the required functions. This is probably a sign that the project is not viable as currently defined. While this may seem negative, actually it is not. It is better to reveal a project as being impossible early than after a lot of money and time are spent or a public meeting is held to reach the same conclusion.

2.3 HOW VE DIFFERS FROM INITIATIVES AND CERCLA FEASIBILITY STUDIES

VE is a systems methodology that has been in use for half a century. Initiatives come and go—sound methodologies, on the other hand, remain and are refined over time because they add value. When performing a VE analysis, other management tools, such as Total Quality Management, the Experience Curve, Simulation, Business Risk Analysis, Just-In-Time Resource Management, and others may be used to enhance the VE process. These other tools can be used to help a VE analysis—not compete with it.

As a systems methodology, VE differs from the typical CERCLA feasibility study in two major respects.

1. The CERCLA feasibility study is performed once and only after the project is well underway (after the remedial investigation). VE studies differ in that they can be performed at the start of a project (i.e., project definition) and can be performed at various key phases of the project (e.g., at the start of the project, during the selection of the cleanup alternative, and for design optimization).
2. The CERCLA feasibility study process does not use function analysis to arrive at the preferred alternative and instead depends on brainstorming. Conventional brainstorming can be a haphazard, hit-or-miss approach. VE studies use function analysis to methodically arrive at optimal solutions.

3. THE VE PROCESS

The sections below describe the standard five phase VE job plan and offer recommendations for a successful VE analysis and VE program.

3.1 FIVE-PHASE VE JOB PLAN

A successful VE analysis requires careful planning. This planning is embodied in a VE job plan, as shown in Fig. 5. The job plan is used to organize the analysis so that the right problem is identified and solved. There are five phases in the job plan: (1) information phase, (2) creative phase, (3)

evaluation phase, (4) development phase, and (5) recommendation phase. The sections below describe these phases in more detail.

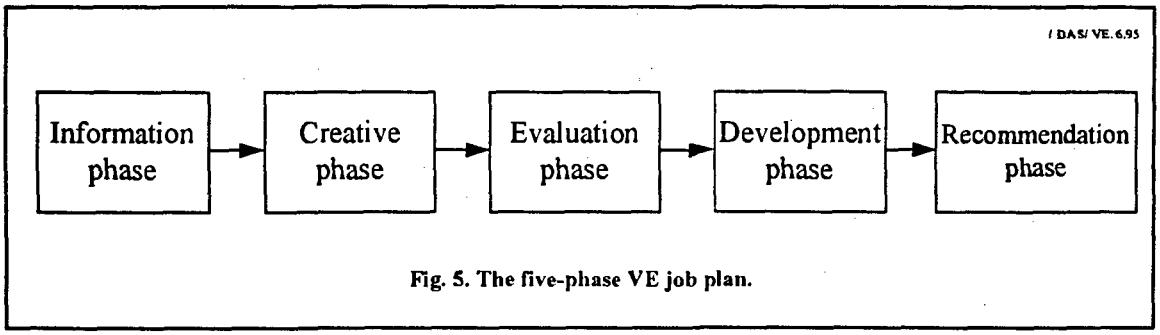

Fig. 5. The five-phase VE job plan.

By following the job plan, several key benefits result. The job plan requires that a specific problem be defined and solved using an organized approach. This helps ensure that VE studies are short, concentrated efforts and not expensive, drawn out exercises. With a job plan, the team knows when to stop, i.e., the team defines its end state and knows when it has achieved success. It directs attention toward high-cost areas, schedule problems, or other problems to get the best overall solution. It also forces people to think more deeply to draw out better solutions.

3.1.1 Information Phase

In the information phase, the VE analysis team is chosen, all necessary background information related to the project is gathered, and function analysis is performed. The purpose of this phase is to identify those areas that represent the greatest opportunity for improvement. The bullets below provide more guidance on exactly what is done during this phase.

- Select the project team for the VE analysis. If the VE analysis is being conducted to define an ER project at its start, this team will typically consist of the VE analysis facilitator, the project manager and core project technical team (excluding project analysts, finance officers, etc.), the customer, regulators, an environmental regulatory specialist, a cost estimator, and a health and safety specialist. For a VE analysis being conducted during the feasibility or design phase, more representation from engineering disciplines is needed.
- Convene the team in a sequestered environment and describe the VE methodology. Typically this is done by the project manager and VE analysis facilitator. The facilitator is responsible for explaining the VE process and keeping the team on track. The quality of the facilitator can make or break a VE analysis. The team needs to be sequestered and immune from interruptions and absences to achieve superior results.
- Identify customer needs and wants. It is important to define exactly who the customer is and what they expect. While this may seem obvious, it deserves careful planning, because if the wrong customer is identified or if the customer's needs and wants remain nebulous, the project is in trouble from the outset.
- Gather needed data. If a VE analysis is being conducted at the start of the project, pertinent information would include such things as site history, knowledge of contamination, regulatory

requirements, basic cost data, etc. This information is commonly available from a preliminary assessment under CERCLA or the equivalent. If a VE analysis is being conducted on the remedial design for a project, the relevant information would include data that formed the design basis and design criteria and cost and schedule information. Accurate and detailed life cycle cost information for the project is important. Additional information that should be gathered is that of constraints, such as environmental, safety, and health constraints. System requirements also should be included, such as treatment efficiency, throughput rates, etc. VE proposals that are generated must consider these constraints and requirements.

- Define the project objective and list the functions required to satisfy that objective.
- Create a FAST diagram by arranging functions in their proper position.
- Allocate cost (or time or other resource of interest) to the functions on the FAST diagram (similar to allocating cost estimates to a work breakdown structure). The purpose of this step is to identify the important few cost (resource) elements and focus on them (using the Pareto theory).

Two example forms, the "Team Member Identification" form for documenting the analysis participants and the "Function Analysis Summary" form for allocating costs to the functions is included in Appendix A. They may prove helpful for most teams and thus are included in this guidance document. The forms in this appendix may be used but are not required.

3.1.2 Creative Phase

In the creative phase of the VE job plan, the goal is to identify solutions. The knowledge gained in the information phase is used to generate ideas about how to solve the problem under review to satisfy all required functions while reducing costs. This phase is typically facilitated by a brainstorming session among the VE team members. All ideas generated are recorded and judgement of ideas is withheld until the next phase. The creative phase is vital to the success of the analysis. Remember Albert Einstein's cogent point that "Imagination is everything, knowledge is nothing." Dramatic innovation and progress can only be made when people use their imaginations. Unfortunately, studies have shown that when any group of people meet there is *only a 30% chance* that information and ideas unique to each individual will be shared with the group.[1] This is a very important and concerning statistic. To be successful, information and ideas from each individual must be brought out for consideration. This requires a conscious effort by a qualified team leader coaching the team members and can only be achieved through hard work. The bullets below provide more guidance on exactly what is done during the creative phase.

- Encourage participation of the entire analysis team.
- Perform a brainstorming session to identify alternate solutions that satisfy the functions identified in the information phase.
- List all ideas, but do not criticize them.

An example "Creative Idea Listing" form that may be used is included in Appendix A.

[1]Stasser, G., 1992. "Pooling of unshared information during group discussion." In Wood, W., and Simpson, J., *Group Process and Productivity*, Sage Publishing Co., pp. 48–76.

3.1.3 Analysis Phase

The analysis phase of the VE job plan involves the team jointly analyzing and judging all ideas generated in the creative phase to select viable alternative solutions. Ideas are evaluated according to their potential for project improvement and cost savings. Those ideas considered worthy of further consideration are given a numerical ranking, and the highest ranking ideas are considered viable alternatives. Ideas that cannot be accurately estimated but are thought to represent improvements to the project are labeled "suggestions." The bullets below provide more guidance on exactly what is done during this phase.

- Review each idea against pertinent criteria selected by the team.
- Eliminate unworkable ideas.
- Categorize ideas and modify them, if needed.
- Assign a champion for each idea. The champion is responsible, in the next phase, for developing that idea into a VE proposal. If no champion can be found for an idea, delete it.

An example "Value Engineering Proposal" form to describe VE proposals and a "Creative Idea/Evaluation" form to evaluate ideas are included in Appendix A.

3.1.4 Development Phase

The development phase of the VE job plan involves developing each viable alternative into a complete and concise VE proposal (alternative). This requires taking into account all costs attributed to the alternative, including life cycle cost comparisons where necessary. Advantages, disadvantages, and a short narrative description are written during this phase, accompanied by supporting sketches, calculations, cost work sheets, etc. The bullets below provide more guidance on exactly what is done during this phase.

- Judge each idea's technical integrity by asking:
- Will it work?
- What does it cost?
- What are the advantages?
- What are the disadvantages?
- Will the customer be receptive to this idea?
- Is the idea compliant with requirements and constraints?

Appendix A includes an example "VE Proposal Justification" form for analyzing VE proposals, a "Sketches/Calculations" form, and a "Potential Cost Savings Summary" form.

3.1.5 Recommendation Phase

The recommendation phase of the VE job plan involves briefing management regarding the proposed alternatives. This gives management an opportunity to make comments and/or ask questions regarding the results of the analysis. Following this briefing a concise written report is issued that documents the VE process used. This report is then the basis for implementing the proposals into the project or process being studied and provides the basis for validating the improvements. The bullets below provide more guidance on exactly what is done during this phase.

- Prepare a concise oral report for management that highlights the original problem, the recommended VE proposals to adopt, and their expected impact.
- Prepare a concise written report to document the process used, identify the team and all participants, and document all recommendations (VE proposals).

3.2 IMPLEMENTATION RESOURCES

The most important resource for conducting a successful VE analysis on a project is a commitment by management to make it work. Next to this, the choice of the VE analysis facilitator is key. For ER projects, there are implementation resources both inside and outside of Energy Systems. The internal resources include central ER and Central Engineering Services. The external resources consists of subcontractors. The advantages and disadvantages of using internal versus external support are juxtaposed below.

Support Source	Advantages	Disadvantages
Internal	Understands DOE environment Less costly Get support sooner	Few trained facilitators
External	Better accepted as "experts" than in-house staff Can share project experience of other sites	More costly May have difficulty with complex DOE environment May have difficulty understanding ER project work

For help in locating a facilitator or planning a VE study, contact the ER VE program manager.

3.3 KEYS TO A SUCCESSFUL VE PROGRAM

The following principles are key to having a successful VE Program in ER.

- Senior management must visibly support VE.
- The customers must be involved in the process.

- It must be integrated into normal business operations.
- Successes using VE must get publicized and shared.
- Employees must be recognized for those successes.

3.4 KEYS TO A SUCCESSFUL VE ANALYSIS

The following principles are key to having a successful VE analysis.

Planning

- Use VE early in the project.
- Define the VE analysis crisply.
- Select VE team members who are subject matter experts.
- Use unbiased outside experts who will vigorously challenge assumptions and decisions.
- Include decision makers on the team, if possible.

Conducting the analysis

- Use a trained and experienced VE analysis leader.
- Follow the VE job plan.
- Use function analysis.
- Identify and challenge excessive specifications and requirements.
- Reuse materials in place of new fabrication.
- Use standardized parts, materials, software, hardware, and designs in place of custom ones.
- Eliminate unneeded finishing of parts and materials.
- Eliminate unnecessary features.
- Eliminate over design.
- Sequester the team members and prohibit interruptions and absences.
- Get involvement of all team members.
- Document the results.
- Implement the recommendations.

4. GRADED APPROACH TO VE IMPLEMENTATION

A graded approach to implementation is a process by which the level of analysis, documentation, and actions performed in a VE analysis are made commensurate with the following considerations:

- total estimated cost of the project;
- level of visibility of the project;
- technical complexity of the project;
- organizational complexity of the project;
- relative importance of the project to safety, environmental, safeguards, and security; and
- magnitude of project hazards.

The important point is to balance the amount of VE employed with the project in question. For example, a complex project with many structures, systems, components, organizational interfaces, and challenging technical and regulatory issues will require more resources for the one or more VE studies required. For such a project, it may be necessary to bring in outside technical experts and facilitators and a large team effort for a week or more. This type of analysis typically would have a formal job plan. Conversely, for a small project with few or no challenging issues, the team may choose to perform a less formal and quick analysis using the project team alone with no assistance from outside experts. The team may forgo a formal job plan and instead may focus on function analysis. This guidance document cannot list all possible project types and scenarios and explain what level of VE is appropriate for each one. Each program or project manager must make that call. When asked, the ER VE program manager will provide recommendations and assistance to project managers in making this decision.

Appendix A

SAMPLE FORMS

The following forms are provided to help in a VE analysis,
but they are not required.

Team Member Identification Form
Function Analysis Summary Form
Creative Idea Listing Form
Proposal Form
Creative Idea/Evaluation Form
Proposal Justification Form
Sketches/Calculations Form
Potential Cost Savings Summary Form

ER Value Engineering Study
Team Member Identification

Project Title _____

Project Manager _____

Total Estimated Cost _____ Date _____

VE Study Team

Name	Org.	Phone	FAX	Bldg	MS	E-mail ID

Project Team

Name	Org.	Phone	FAX	Bldg	MS	E-mail ID

ER Value Engineering Study
Function Analysis Summary

Project Name_____ Date_____

No.	Description	Function			Cost	Worth	Comments
		Verb	Noun	Kind*			

*Kind: B=Basic S=Secondary

ER Value Engineering Study
Creative Idea Listing

Project Name_____ Date_____

No.	Creative Idea-DO NOT JUDGE!

ER Value Engineering Study Proposal

Project	Date	Proposal No.
Item		

Original Concept: (attach a sketch where appropriate)

Proposed Change:

Cost Summary	Labor & Materials	Indirect	Life-cycle Cost	Total Cost
Original Concept				
Proposed Change				
Savings				

ER Value Engineering Study
Creative Idea/Evaluation

Project	Date

Creative Idea Listing		Idea Evaluation							
No.	Creative Idea	Advantages	Disadvantages	$	SC	CM			Total

LIST ALL IDEAS BEFORE RATING!

Significant Improvement +2, +1, 0, -1, -2 Significant Degredation

$ - Cost SC - Schedule CM - Compliance

ER Value Engineering Study
Proposal Justification

Project	Date	Proposal No.
Item		

Advantages:

Disadvantages:

Changes:

Discussion:

ER Value Engineering Study
Sketches/Calculations

Project	Date	Proposal No.
Item		

ER Value Engineering Study
Potential Cost Savings Summary

Project	Date
Item	

		Cost Savings				
No.	Description	Original Cost	Alternative Cost	Initial Savings	O & M Savings	Total Savings

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