Value Engineering

The Methodology for Maximizing Project Value

Table of Contents

Chapter 1 – Value	1
Introduction	1
What is Value Engineering?	2
History	3
Value Study	5
Job Plan	5
Value Engineering Principals	9
Reasons for Poor Value	. 12
Chapter 2 – Preparation and Pre-Workshop Activities	. 15
Introduction	. 15
Definitions	. 15
Common Activities	. 15
Pre-Study Meeting	. 16
Specific VE Project Plan Features	. 16
Value Study Team Structuring	. 17
Team Operation	. 18
Performance Attributes	. 18
Attributes and Requirements.	. 18
Value Study Agenda	. 20
Typical 5-day Value Study Agenda	. 20
Data Required for a Value Study	. 22
Pareto's Law	. 23
Cost Model	. 24
Pre-Workshop Checklist	. 25
Chapter 3 – Teamwork	. 26
Introduction	. 26
Content & Dynamics	. 26
Relationships	. 28
Communication is a two-way street	. 28
Team Member Participation Expectations	30
Value Study Ground Rules	31
Team Members' Responsibilities	32

The Role of the Value Study Leader	
Principles of Social Behavior	
Promoting Cooperation	
Team Building	
Communication Exercises	
Problem Solving/Decision Making Exercises	
Planning/Adaptability Exercises	
Trust Exercise	
Conflict	
Set goals and ground rules in advance	
Look for warning signs	40
Remain neutral and defuse the emotions	40
Conclusion	
Chapter 4 – Workshop Activities Information Phase	43
Introduction	43
Definitions	43
Common Activities	43
Obtain project data	43
Confirm the most current project concept	
Project Overview	
Constraints and Controlling Decisions	
Gather All Types of Information	45
Obtain Information	45
Obtain Complete, Pertinent Information	
Work with Specifics/Facts	
Get all Available Costs	
Information Phase Checklist	47
General	
Specifications	
Engineering and Design	
Methods and Processes	
Materials and Procurement	49
Maintenance	

Chapter 5 – Workshop Activities Function Analysis Phase	. 50
Introduction	. 50
Definitions	. 50
Common Activities	. 50
Determine the Functions	. 51
Defining Functions	. 52
Purpose and Need	. 53
Review the Purpose and Need Requirements	. 53
Identifying Functions	. 54
Classifying Functions	. 56
Basic Functions	. 56
Secondary Functions	. 57
Higher Order Functions	. 57
Lower Order Functions	. 57
Organize Functions	. 58
FAST Diagramming	. 59
How FAST works	. 60
Critical Function Logic Path	. 60
How and Why	. 60
Supporting Functions	. 61
Scope of the Study in the FAST	. 61
Focus on the Function	. 62
Constructing a FAST Diagram	. 63
Assigning Cost to Functions	. 66
Function Worth & Cost	. 68
Function Analysis Phase Checklist	. 69
Chapter 6 - Workshop Activities Creative Phase	. 70
Introduction	. 70
Challenge the present method of performing a function	. 70
Definitions	.71
Common Activities	.71
Positive and Negative Factors	.71
Habitual Blocks	. 72

Perceptual Blocks	72
Cultural Blocks	72
Emotional Blocks	72
Use Creative Techniques	73
Creative Thinking Techniques	74
Brainstorming	74
Brain Writing	75
Creative Phase Checklist	77
Chapter 7 – Workshop Activities Evaluation Phase	78
Introduction	78
Definitions	78
Common Activities	78
Key Questions	80
Evaluation Techniques	80
Comparison	80
Advantages vs. Disadvantages	80
Ranking	81
Idea/Criteria Method	83
Idea/Objective Method	84
Paired Comparison Analysis	84
Performance Measures	86
Life Cycle Costing	88
Definitions	88
Time Value of Money	89
Life Cycle Cost Example	93
Evaluation Phase Checklist	95
Chapter 8 – Workshop Activities Development Phase	96
Introduction	96
Definitions	96
Common Activities	96
Reference Materials	97
Procedures	98
Develop Specific Alternates	99

Testing	9
Reasons for Rejecting VE Recommendations99	9
Develop Implementation Plans	О
Recommendation Examples	О
Development Phase Checklist	9
Chapter 9 – Presentation Phase11	1
Introduction	1
Definitions	1
Common Activities	1
VE Recommendation or Proposal	1
Value Study Report	2
Written Reports	3
Oral Presentation	3
Effective Oral Presentations	4
Presentation Structure	5
Giving the Presentation	6
Visual Aids	7
Gaining VE Recommendation Acceptance	7
Presentation Checklist	С
Chapter 10 – Implementation	1
Introduction	1
Definitions	1
Common Activities	1
Implementation Investment	2
Expediting Implementation	2
Post-Study Checklist	3
Appendix124	4
Appendix A	5
Active Verb/ Measurable Noun12	5
Appendix B	6
Being a Good Team Member120	6
Guidelines for a Virtual Workshop	6
Appendix C	8

Value Engineering Job Plan	
Appendix D	
FAST Diagram Examples	
Widening Project	
Interchange Project	
Fish Passage	
Appendix E – Agenda Templates for use in Value Engineering Workshops	
1 Day Project Element Focused VE	
3 – Day Agenda	
3 ½ – 4 Day Agenda	
Typical Prep Session Agenda	
Example VE Invite to Team Members	
Appendix F – Other Tools and Templates	
T-Chart	
Paired Comparison	141
FAST Diagram Template	
Recommendation Development Template	
Appendix G	
Glossary of Terms	

Figures

Figure 2 Value Engineering Milestones	4
Figure 3 Value Engineering Job Plan	. 6
Figure 4 Point of Decision Table	8
Figure 5 Typical Performance Attributes	19
Figure 6 Example Categories of Work (items 1 thru 4 represent 87% of the costs	23
Figure 7 Example Pareto	24
Figure 8 Active Verb / Measurable Noun	52
Figure 9 Functions of a Hammer	55
Figure 10 Function Classification	58
Figure 11 FAST Diagram Elements	59
Figure 12 Example - FAST Diagram – Grade Separated Railroad	62
Figure 13 Constructing a FAST Diagram	63

Figure 14 "AND" & "OR" in the Logic Path of FAST Diagrams	
Figure 15 FAST Diagram – Hammer	65
Figure 16 Function Value Resource Matrix	
Figure 17 FAST Diagram Grade Separated Railroad	
Figure 18 Evaluation - Advantages / Disadvantages	
Figure 19 Idea Evaluation Worksheet	
Figure 20 Rating Alternatives against Criteria	
Figure 21 Performance Attribute Matrix - Options	
Figure 22 Performance Attribute Matrix	
Figure 23 Weighted Performance worksheet	
Figure 24 Time Value of Money	
Figure 25 Time Value of Money	
Figure 26 Life Cycle Calculation Example	94
Figure 27 Example Recommendation	
Figure 28 Example Recommendation 2	
Figure 29 VE Job Plan Steps	
Figure 30 Example FAST Diagram - Widening	
Figure 31 Example FAST Diagram - Interchange	
Figure 32 Example FAST Diagram - Fish Passage	
Figure 33 1 day agenda	
Figure 34 3 day agenda	
Figure 35 4 day agenda	
Figure 36 T chart template	
Figure 37 Paired Comparison Template	141
Figure 38 FAST Diagram Template	
Figure 39 Recommendation Form Template	
Figure 40 Glossary of Terms	

Chapter 1 – Value

Introduction

Value Engineering (VE) is the most effective technique known to identify and eliminate unnecessary costs in project design, construction, operations and maintenance. Its application to transportation projects is less well known, but its effectiveness in these areas has been highly successful.

The terms Value Analysis and Value Engineering are considered to be synonymous. The term "Value Engineering" or "VE" is used throughout this text. Definitions

Certified Value Specialist (CVS) - CVS is the highest level of certification attainable through SAVE International. Designation is reserved for Value Specialists and Value Program Managers who have demonstrated expert level experience and knowledge in the practice of the value methodology.

Job Plan - A sequential approach for conducting a value study, consisting of steps or phases used to manage the focus of a team's thinking so that they innovate collectively rather than as uncoordinated individuals. It provides the structure for the Value Study which is part of a 3-stage process

- 1. Pre-Study preparation
- 2. Value Workshop which applies the 6-Phase Job Plan¹
- 3. Post-Study documentation and implementation

Value Methodology - A systematic process used by a multidisciplinary team to improve the value of projects through the analysis of functions.

Value Methodology Associate (VMA) - VMA is a recognition designed for individuals who are new to the value methodology. A VMA is encouraged to progress to CVS certification.

Value Standard - Establishes the specific six-phase sequential Job Plan process and outlines the objectives of each of those phases.¹ It does not standardize the specific activities that are used to accomplish each phase.

Value Study - The application of a value methodology by SAVE International certified professionals using the Value Job Plan.

¹ WSDOT has an additional Phase 7 – Implementation

What is Value Engineering?

Value Engineering is a systematic process used by a multidisciplinary team to improve the value of a project through the analysis of its functions. Value is defined as a fair return or equivalent in goods, services, or money for something exchanged. Value is commonly represented by the relationship:



Figure 1 Value Formula

Where function is measured by the performance requirements of the customer and resources are measured in materials, labor, price, time, etc. required to accomplish that function. Value methodology focuses on improving value by identifying alternate ways to reliably accomplish a function that meets the performance expectations of the customer.

Value Engineering may be defined in other ways, as long as the definition contains the following three (3) basic precepts:

1. An organized review to improve value by using multi-disciplined teams of specialists knowing various aspects of the problem being studied.

2. A function oriented approach to identify the essential functions of the Project, product, or process being studied and the costs associated with those functions.

3. Creative thinking which uses recognized techniques to explore alternate ways of performing the functions at a lower cost or to otherwise improve the project, product, or process.

Value methodology is applied using a process known as the "Job Plan". The purpose of the Job Plan is to guide the Value Study Team through the process of identifying and focusing on key project functions in order to create new alternates that will result in value improvements.

History

During World War II, product innovation was required because of material shortages. The Value Engineering concept evolved from the work of Lawrence Miles who, in the 1940's was a purchase engineer with the General Electric Company (GEC). At that time, manufacturing industry in the United States was running at a maximum capacity to supply the allies with arms.

There were shortages in steel, copper, bronze, nickel, bearings electrical resistors, and many other materials and components. GEC wished to expand its production of turbo supercharger for 824 bombers from 50 to 1000 per week.

Mr. Miles was assigned the task of purchasing the materials to permit this. Often he was unable to obtain the specific material or component specified by the designer, so Miles reasoned, 'if I cannot obtain the product, I must obtain an alternative which performs the same function'.

Where alternatives were found they were tested and approved by the designer.

In 1947, Mr. Miles and his associates performed many analyses of product costs and function and developed a step by step system, which was named Value Analysis (VA). The new methodology of VA was developed, tested, and proven to be highly effective. However, it was not until 1952 that VA began its growth throughout industry. In that year Mr. Miles conducted his first workshop in Value Analysis. Some 60 people from various General Electric plants and business activities obtained 160 hours of basic training in VA techniques.

In 1954, the U.S. Navy Bureau of Ships (BUSHIPS) was looking for a method to reduce the cost of ships and equipment. BUSHIPS had heard of the General Electric VA program and obtained the training for its personnel. The Navy directed its effort at cost avoidance during the design stage and called its program Value Engineering, though it used the same techniques as the General Electric Value Analysis program.

Since the middle 1950's, when BUSHIPS became active in the Value Analysis program and established its own Value Engineering Branch, the Federal government's interest in this field has grown.

As the value methodology gained in popularity, a group of practitioners formed a learning society to share insights and advance their innovative capabilities. Thus, in 1959, the "Society of American Value Engineers" was incorporated in Washington, DC.

Soon, the value methodology was used to improve the value of projects in government, the private sector, and the manufacturing the construction industries and value concepts spread worldwide.

Concurrent with this growth, a number of other value improving tools, techniques, and processes emerged, many of which were complementary to and were integrated with the value concepts. In an effort to attract the developers and practitioners of these emerging methods to their membership, the name of the society was changed to "SAVE International" in 1996.

Figure 2 Value Engineering Milestones

1947	Mr. Lawrence D. Miles; General Electric Staff Engineer, was assigned to			
	study a new design concept and developed a technique, which he			
	named 'Value Analysis," to generate cost savings based primarily on an			
	analysis of product functions and costs.			
1952	Mr. Miles conducted the first Value Analysis workshop-seminar.			
1954	The U.S. Navy Bureau of Ships applied VA to cost improvement during			
	design, calling it Value Engineering.			
1959	The Society of American Value Engineers (SAVE) was founded in			
	Washington, D.C., to unite all practitioners and promote the growth of the			
	profession.			
1961	VE clauses were established in Armed Forces Procurement Regulations			
	permitting contractor incentive sharing in VE contract cost reductions.			
1962	The Department of Defense made VE incentive clauses a prerequisite for all			
	procurement contracts in excess of \$100,000.			
1963	The U.S. Navy Bureau of Yards and Docks was the first agency to write a VE			
	incentive clause into an awarded contract.			
1967	Two days of VE hearings by the U.S. Senate committee on Public Works.			
1970	The U.S. Congress endorses VE by recommending its use on Federal-aid			
	highway projects.			
1973	SAVE established a program for certification of Value Specialists.			
1975	The U.S. Department of Transportation, Federal Highway Administration,			
	awarded a contract to a private firm to conduct its national training			
	program 'Value Engineering for Highways."			
1996	In an effort to attract the developers and practitioners of these emerging			
	methods to our membership, the name of the society was changed to			
	"SAVE International"			

Value Study

In order to qualify as a Value Study, the following conditions must be satisfied.

A. The Value Study Team follows an organized Job Plan that includes, at a minimum, the six phases identified in this standard. Function Analysis, as defined in this document, is performed on the project.

B. The Value Study Team is a multidisciplinary group of experienced professionals and project stakeholders. Team members are chosen based on their expertise and experience with the project. Project team members may be on the VE team, but to provide an unbiased view of the project, it is important for the VE team to be mainly comprised of individuals who have relevant expertise; but are not directly involved with the project.

C. The Value Team Leader is trained in value methodology techniques and is qualified to lead a study team using the Job Plan. The SAVE International Certification Board certifies, with the designation Certified Value Specialists (CVS), those individuals who have met specified training requirements and have demonstrated competency in the application of the Job Plan. The Team Facilitator shall be a CVS as recognized by SAVE International.

Job Plan

The value methodology is a systematic process that follows the Job Plan. A value methodology is applied by a multidisciplinary team to improve the value of a project through the analysis of functions. The Job Plan consists of the following sequential phases:

- 1. Information Phase The Value Study Team reviews and defines the current conditions of the project and identifies the goals of the study.
- 2. Function Analysis Phase The Value Study Team defines the project functions using a two-word active verb/ measurable noun context. The team reviews and analyzes these functions to determine which need improvement, elimination, or creation to meet the project's goals.
- **3.** Creative Phase The Value Study Team employs creative techniques to identify other ways to perform the project's function(s).

- 4. Evaluation Phase The Value Study Team follows a structured evaluation process to select those alternates that offer the potential for value improvement while delivering the project's function(s) and considering performance requirements and resource limits.
- **5. Development Phase** The Value Study Team develops the selected ideas into alternatives (or proposals) with a sufficient level of documentation to allow decision makers to determine if the alternative should be implemented.
- 5. Presentation Phase The Value Team Leader develops a report and/or presentation that documents and conveys the adequacy of the alternative(s) developed by the team and the associated value improvement opportunity.



Figure 3 Value Engineering Job Plan

The "systematic application of recognized techniques," referred to in the definition of value engineering, is embodied in the Job Plan. It is an organized plan of action for accomplishment of VE studies, including implementation of recommended changes in a design.

No single phase of a Value Study is apt to show anything startling to new Value Study Team members. Rather, it is the arrangement and application of the segments of the VE methodology, the use of creative techniques at the proper time, and the general philosophy that are new and unique. This is what makes VE effective. It is not "something we (designers) do all the time."

Value Engineering is a procedure enabling one to exercise underutilized human creative potential to solve problems. This is accomplished through adherence to a precise sequence of steps known as the Job Plan.

The key features separating the Job Plan from other methods used to solve routine engineering problems or to carry on cost reduction activities are:

- Analysis of function
- Use of specific creative effort to develop many design alternatives
- The principle of not degrading the performance needed by the user
- Assigning costs to perform each function.

In VE, as in other problem-solving methods, a systematic approach produces better results than undisciplined ingenuity. Strict adherence to the Job Plan provides:

- 1. A vehicle to carry the Value Study from inception to conclusion.
- 2. A convenient basis for maintaining a written record of the effort as it progresses.
- 3. Assurance that consideration has been given to facts that may have been missed in the creation of the original design or plan.
- 4. A logical separation of the Value Study into units that can be planned, scheduled, budgeted, and assessed. The use of the Job Plan and its associated techniques of analysis of function and application of creativity often yields more cost reduction without adversely affecting performance. In many cases, through design simplification, reliability, maintainability and quality are improved.

The following table illustrates the actions required, decisions to be made, and the responsible decision-maker at key points in the Value Study.

POINT OF DECISION	ACTION / CONSIDERATION	DECISION	WHO MAKES THE DECISION
Selection of Project	Select projects for the	Decide to proceed	Management
	study.	with a study for the	
	Estimate the potential of	project	
	the study candidates		
After the Information	Select specific elements	Decide to proceed	Value Study Team
Phase	within the project for	with study for the	
	study	project	
After the Evaluation	Select Ideas likely to be	Decide to proceed	Value Study Team
Phase	successful.	with the Development	
	Estimate the potential of	of the best Ideas	
	the Ideas		
After the Presentation	Consider the impact of	Decide to Implement	Management
Phase	the proposed	the proposed	
	Recommendations	Recommendations	
Upon Completion of	Review the results	Decide further	Management
the Job Plan		program action	
Job Plan Points of Decision			

Figure 4 Point of Decision Table

To apply the Job Plan, two important factors must be recognized:

- 1. An effective VE effort must include all phases of the Job Plan. Omissions of any one of the phases will hamper accomplishment of the objectives. The amount of attention given to each phase, however, may differ from one project to another.
- 2. Execution of the Job Plan requires a team effort. The cooperation and active participation of several people produces the most effective results. Group dynamics play an important role, and illustrate that the results of a team of five professionals is greater than the sum of five individual efforts.

The Job Plan is a systematic approach that has been used, tested, and proven to work. Experience has shown that the application of this plan produces startling results in reducing costs and simplifying designs.

During normal cost reduction, one is inclined to analyze an item from the standpoint of how to reduce the cost of the elements which make up the item. One "cheapens" the parts until quality and performance are sacrificed.

An early step in the Job Plan requires those making the study to clearly define the functions performed by the item under study. Adherence to the Job Plan ensures that

time is available for essential creative work and the necessary evaluation to select the best design alternative for further development.

Finally, the Job Plan concludes with specific recommendations, the necessary data supporting them, the required implementing actions, and a proposed implementation schedule.

Value Engineering Principals

The Pursuit of Value

- What is it?
- What does it do?
- What must it do?
- What does it cost?
- What else will do the job?
- What does that cost?

Use Teamwork

A fundamental principle of VE is to employ teamwork. In a complex design, with many different functions and people contributing to project cost, cost-effectiveness is enhanced when they blend their talents toward that common objective.

Overcome Roadblocks

Roadblocks are obstacles in the path of progress, often occurring whenever a change is proposed. Some roadblocks are real (those of others), and some are imaginary (those of our own). They are both an expression of resistance to change.

Value Engineering techniques are designed to help "overcome roadblocks;" therefore, their existence should be recognized and one should be prepared to refute them when they are encountered.

Use Good Human Relations

Because VE is concerned with creating change, it is concerned with human relations. In VE, there is a high degree of dependence on cooperation with other people. Therefore, good or poor human relations can relate directly to success or failure of the project. The effectiveness of a Value Team Leaders' efforts depends upon the amount of cooperation they are able to obtain from cost analysts, engineers, designers, managers, etc. If one is sensitive in their approach, be diplomatic when resolving opposing viewpoints, and tactful in questioning a design requirement or specification, they will minimize the problem of obtaining the cooperation they must have to perform effectively.

Convince the people you work with, that you are asking, not demanding, but suggesting; that you are not criticizing, but helping, not hindering; and you are interested, not bored with them. Some of the areas where good human relations must be employed are:

- 1. In fact-finding--getting good information from people requires their cooperation.
- 2. In creativity--good ideas come from people who are properly motivated. Get all team members involved. Don't let anyone dominate the team.
- 3. In implementation--receptivity to alternates has to be generated.
- 4. Some general guidelines for good human relations in Value work are:
 - Treat people fairly and honestly.
 - Give credit to others.
 - Be consistent--Let people know what to expect.
 - Act in ways which avoid personal loss or embarrassment to those you contact or those affected by your action.
 - Be a good listener.
 - Don't harm the other person's dignity.

Be a Good Listener

Listen attentively when explanations are made concerning problems that arise. The explanations almost always provide clues that otherwise would require hours of investigation and research. The experience of the team members will enable them to detect the true problem if the person making the explanation is given every opportunity to express his ideas.

Also, the person who objects to a proposal may give an indication as to how it may be improved or modified to enable approval.

Use Key Questions

The VE approach is a questioning approach. In order to get answers, questions must be asked.

Use Checklists

As an aid to the practicing Value Team Leader, the key questions of the Job Plan have been incorporated into check lists found in the chapters describing each phase. The checklists are not all-inclusive. The lists do, however, provide a good start for the questions to ask.

Record Everything

Don't trust your memory. During all phases of the study, record the information you have gained through interview; write down your ideas, the questions that need to be answered, and the details of your developed ideas; You will need to use this data in each succeeding step of the Job Plan and in preparing the workbook, the study summary, and your recommendations.

Use Good Judgment

Everyone has been endowed with the capability to apply common sense and good judgment. Often, however, the environment influences one's ability in this area. Studies made in industry have shown that 70 percent of people do things the way they think they should be done in less than half the time.

In VE we should employ the philosophy "if it doesn't seem right, it probably isn't" or "if I wouldn't spend my money for it, it's probably not good value, and I shouldn't spend public funds for it."

Value Team Leaders should have the courage of their convictions and take action to change things that their good judgment tells them are wrong.

Reasons for Poor Value

Lack of Information

Failure to get sufficient relevant facts. This can be caused by lack of knowledge or misunderstanding of the full requirements of the original project plan, and is one of the most common reasons to conduct a Value Study. If one hasn't sufficient information to make a decision, they are "guessing". Too many of today's decisions are based on feelings rather than facts.

Honest Wrong Beliefs

Some decisions are based on erroneous beliefs rather than on true facts. For example, planners who make decisions on what a design should accomplish, may not properly sense the public's needs. Design decisions can also be based on wrong beliefs. Because of one unfortunate experience (personal or through hearsay) where a poor choice of material was made, a designer could become biased against the use of that material for any project.

Habitual Thinking

Thinking and doing things in the same way is a frequent cause of poor value. Most people have a tendency to re-use what worked the last time, or to copy the standard set by others. This is a defensive measure designed to minimize risk, and is promoted by management through rigid use of standard designs, procedures, customs and tradition without consideration of changing needs or technology. Keeping up with the state-ofthe-art is essential in today's complex world.

Risk of Personal Loss

Any good engineer or manager knows that nothing is "for sure". They also know that anything that is done over and over again contains less risk than something new. Failure of a new approach could cause personal loss to the decision-maker. Decisions, therefore, are generally based on past experience of "nearly-related" data rather than on something new or unfamiliar.

Reluctance to Seek Advice

Designers and planners are often very reluctant to seek advice from others; to admit that maybe they don't know the answer. Architects, planners and engineers should seek the advice of competent experts if maximum design value is to be achieved.

Shortage of Time

When a project appears on a long range or annual construction program there is often a critical demand that the project "stay on schedule." Frequently, the time pressure is so great that it is impossible to consider properly, if at all, the value of the design approach being developed. The designers usually finds it necessary to accept the first workable solution to a problem in order to complete the job on time. Seldom is there time to sit back and contemplate ideas, or to design for value by developing alternative approaches. Designs developed under these conditions are normally good candidates for Value study work.

Negative Attitudes

Some people are reluctant to make a change of any kind regardless of the merits of the proposal, especially if the change directly affects their plan or design. Others feel that they always provide for the best value in their approach.

Changing Technology

Rapid strides in the development of processes, products, and materials present constantly changing, and many times lower cost ways, of performing the necessary functions. The total fund of knowledge is now being generated so fast that no one can be expected to be completely current, even in their own field.

Strict Adherence to "Requirements"

Requirements and published standards are often unrealistically specified with reference to performance, materials, safety or procedures. Sometimes requirements are assumed by the planner or designer when not specifically specified. Traditionally, designers have concentrated on developing designs that exceed all known and assumed requirements. The net result is over-design, with attendant waste of tax-payer funds. Requirements should be challenged to determine if they meet a need of the project, or just satisfy the published standards.

Performance at Any Cost

When a problem is identified, the natural reaction is to develop a design that will solve it completely. However, this may lead to a solution with a cost that far exceeds its value. The cost of solving 95 percent of the problem may be within reason, but solving the remainder can increase the cost unreasonably. Solving 95 percent of the problem and using the remaining funds to solve other critical problems may be a more prudent approach.

Poor Human Relations

Lack of good communications, misunderstanding, jealousy and normal friction between human beings is a frequent source of unnecessary costs. Highway projects require the talents of many people, and good human relations are especially critical. If the various specialists on complex projects do not work together, they are likely to work at cross purposes, wasting a great deal of effort, with a final product that does not have good value.

Chapter 2 – Preparation and Pre-Workshop Activities

Introduction

The objective of the Pre-Workshop activities is to plan and organize the Value Study.

Definitions

Cost - The expenditure of resources needed to produce a product, service, or process.

Cost Model - A financial representation such as a spreadsheet, chart, and/or diagram used to illustrate the total cost of families of systems, components, or parts within a total complex product, system, structure or facility.

Project - A temporary endeavor undertaken to create a unique project, process, or result.

Scope - The portion of the overall project that is selected for the value study. The analysis accepts everything within the defined scope in order to focus attention on the functions within those limits.

Common Activities

- Obtain senior management concurrence and support of the job plan, roles, and responsibilities.
- Develop the scope and objectives for the Value Study.
- Obtain project data and information.
- Obtain key documents such as scope of work definition, drawings, specifications, reports, and project estimate.
- Identify and prioritize strategic issues of concern.
- Determine the scope and objectives of the study.
- Develop the study schedule.
- Undertake competitive benchmarking analyses.
- Identify Value Study Team members.
- Obtain commitment from the selected team members to achieve the project objectives.
- Review the project costs.

- Gather appropriate stakeholder information about the project If appropriate, invite Local Agency, or other stakeholders to participate in the Value Study.
- Distribute information to team members for review.
- Develop informational models and diagrams about the project.
- Determine the study dates, times, location and other logical needs.
- Clearly define with management the requirements for a successful Value Study results.

Pre-Study Meeting

The desired outcome of the Pre-Study Meeting is a clear understanding of what management needs to have addressed, what the strategic priorities are, and how improvement will increase organizational value. Establishing the goals and objectives of the Value Study is critical.

It is during this phase that a view is formed as to whether subsequent phases are likely to yield sufficient value to justify the cost of the study within the terms set. It may be appropriate to increase or decrease study parameters at this time. Team members need to be knowledgeable of and committed to achieve the project's objectives.

Specific VE Project Plan Features

All plans should contain the following minimal essential features:

- Description of the objectives and scope of the project in enough detail to ensure direction of the study.
- Goals for the study, and establishment of both an estimated savings target and realistic project study cost.
- Selection of team members with a variety of work skills and experience to conduct the project.
- Designation of the project leader and team members by name.
- Time limitations for completion of each phase of the Job Plan.
- Establishment of a target date for formal presentation of project results.

Value Study Team Structuring

Depending on the scope of the project and the time restraints for completing it, VE team sizes can vary for 3 to 10 team members, and may also have several people assigned to support the team if and when their particular skills are needed.

Selection of members to perform the study should be based on the following criteria, if possible:

- 1. Use individuals who have had prior training in VE.
 - a. The Value Team Leader is trained in value methodology techniques and is qualified to lead a study team using the Job Plan. The SAVE International Certification Board certifies, with the designation Certified Value Specialists (CVS), those individuals who have met specified training requirements and have demonstrated competency in the application of the Job Plan. The Team Facilitator shall be a CVS, as defined by SAVE Certification criteria.
 - b. Team members should have attended the Value Methodology Fundamentals 1 (VMF1) training or at a minimum a one-day VE orientation course. If such experience is unavailable, a suitable orientation guide should be distributed to the team members.
- 2. Identify work experience or background of the team members related to the particular project under study.
 - a. A mix of talent is desired to achieve different points of view.
 - b. Typical team members for a Value Study on a transportation project might include a right-of-way specialist, geotechnical engineer, environmental specialist, structural engineer, design engineer, traffic operations, maintenance, and resident engineer. An experienced cost estimator can be valuable to the team.
- 3. Many studies suffer from overreaction to popular concerns for the environment, liability, and public opinion. If any of these conditions impact the study, it may be well to include representatives of these "adversary groups" as active team members.
- 4. Emphasis should be placed on using the best talent available, rather than obtaining only those who can be spared.

Team Operation

Each member must contribute to the study. The Value Team Leader should determine each person's talents and allocate tasks which make the best use of those skills.

In each phase of the Job Plan, the Value Study Team should carry out both individual and group actions. One member can obtain and organize costs, one can analyze the specifications and identify problem areas, one can get the equipment information, etc.

Each can summarize and document the information so that the team can plan, create, and act to solve the problem.

Performance Attributes

Once the basic functions and requirements are understood and agreed upon relative to project scope, the next step is to begin the process of defining performance. Performance can be divided into two categories:

Attributes and Requirements.

The term "**attributes**" is used to describe performance characteristics that can possess a range of values, while "**requirements**" do not. Attributes are flexible; requirements are not.

A potential solution that does not satisfy a performance requirement cannot be considered. A performance attribute can be further defined by establishing a range of acceptable parameters.

Both performance attributes and requirements should be identified at this early stage of the Job Plan.

The Value Study Team will need to have a clear understanding of both the performance attributes and requirements before moving into the subsequent phases of the Job Plan.

Performance attributes need to be discretely defined and must not overlap in meaning.

Parameters defining the lower and upper range of desired performance should be included as well. Performance requirements should be similarly defined, but more finitely relevant to the actual value of the requirement.

The Value Team Leader should lead this discussion with the project's stakeholders during the pre-study meeting, preferably in the presence of the value team members. Only those attributes identified as most critical in meeting the project's purpose and need should be included. For most projects, 4 to 8 performance attributes are usually all that are necessary to do this. The number of performance requirements, however, can vary widely.

Typical Performance Attributes for Transportation Projects			
Performance Attribute	Definition		
Mainline Operations	An assessment of traffic operations and safety on the mainline facility(s), including ramps, and collector-distributor roads. Operational considerations include level of service as well as geometric considerations such as design speed, sight distance, lane widths and shoulder widths.		
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure, including frontage roads. Operational considerations include level of service as well as geometric considerations such as design speed, sight distance, lane widths; bicycle and pedestrian operations and access.		
Maintainability	An assessment of the long-term maintainability of the transportation facility(s). Maintenance considerations include the overall durability, longevity and maintainability of pavements, structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.		
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to businesses and residents relative to access, visual, noise, vibration, dust and construction traffic; environmental impacts.		
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice, business, residents); impacts to cultural, recreational and historic resources.		
Project Schedule	An assessment of the total project delivery as measured from the time of the VE Study to completion of construction.		

A "Paired Comparison Analysis" can be performed to determine which of these attributes are the most important performance aspects that the project must address. See Chapter 7 "Paired Comparison Analysis" for a detailed explanation.

Value Study Agenda

The value study should be timed appropriately to fit within the overall project schedule. In theory, the Value Study should be scheduled during a milestone when the project is undergoing a review period.

Typically a Value Study has been historically five days or 40 hours long. In fact a Value Study should be based on a number of different factors:

- Size and complexity of the project
- Value Study goals and objectives
- Value Study scope
- Size and expertise of the Value Study Team
- Resources available to conduct the study

Typical 5-day Value Study Agenda

Monday

8:00 a.m. - Team Introductions

- 8:15 a.m. Project Team presentation of the project What are the goals and objectives? What are the constraints and controlling decisions? What risks have been identified?
- 9:30 a.m. Stakeholder Issues and Performance Measures
- 10:30 a.m. Site Visit (one hour for lunch)
- 2:00 p.m. Capture site visit observations
- 2:30 p.m. Validate Cost Estimate
- 5:00 p.m. Adjourn for the day

Tuesday

- 8:00 a.m. Review of project information
- 9:00 a.m. Functional Analysis Define functions
- 11:30 a.m. Lunch
- 12:30 p.m. Team Brainstorming
- 5:00 p.m. Adjourn for the day

Wednesday

- 8:00 a.m. Any new ideas from overnight?
- 8:30 a.m. Team Brainstorming moving into Evaluation
- 11:30 a.m. Lunch
- 12:30 p.m. Evaluation moving into Development of alternates
- 5: p.m. Adjourn for the day

Thursday

- 8:00 a.m. Development of Ideas
- 11:30 a.m. Lunch
- 12:30 p.m. Development of Ideas
- 5:00 p.m. Adjourn for the day

Friday

- 8:00 a.m. Define and evaluate the performance of alternates
- 10:30 a.m. Presentation Preparation
- 11:30 a.m. Lunch
- 12:30 p.m. Team walk-through of presentation
- 2:00 p.m. Presentation of Findings

Data Required for a Value Study

It is important to any Value Study to have certain data available for the team prior to commencement of the study. Here is a list of data that typically would be required for a Value Study on a transportation project.

- Project Scope, Schedule Estimate and Basis of Estimate
- One or two page synopsis of what the project is about and up-to-date Quantities & Cost estimates
- General plan sheets showing the project and current alternates
- A list of the projects constraints and controlling decisions
- Risk Management Plan
- Design Criteria
- Accident Data
- Traffic Data
- Geotechnical Report
- Resurfacing Report
- Hydraulic Report
- Environmental Documents
- X-Sections
- Maps (Vicinity, Land Use, Contour, etc.)
- Aerial Photos
- Various Plans (As-builts, R/W Plans, channelization plans, profiles, and any other plans that are useful)

Pareto's Law

In the late 1800s, Vilfredo Pareto, an economist, established that 80% of the land in Italy was owned by 20% of the population. This was the first instance of a socio-economic law that soon appeared to have universal scope.

The Pareto law, in its generalized form, states that 80 % of the objectives - or more generally the effects - are achieved with 20 % of the means - or more generally the causes or the agents.

Subsequently, it takes 80 % of the means to achieve the remaining 20 % of the objectives. In other words, the cost required to move from 80 % to 100 % of the objective is four times bigger than the one required to move from 0 % to 80 %.

Practically, this entails that, beyond a certain threshold, the marginal cost of improving a situation further (e.g. to increase one's market share in a given market segment) becomes prohibitively high.

The value of the Pareto Principle is focusing on the 20 percent that matters.

MAJOR WORK CATEGORIES	Fill the	ese in deceasing order	
		Value	
STRUCTURE	\$	2,905,480	
GRADING	\$	1,622,560	
OTHER	\$	1,608,844	
PREPARATION	\$	906,214	
HMA	\$	262,695	
TRAFFIC	\$	243,702	
DRAINAGE	\$	200,000	
SURFACING	\$	127,500	
TEMPORARY TRAFFIC CONTROL	\$	91,928	
EROSION CONTROL AND PLANTING	\$	84,265	

That 20% produces 80% of your results. Identify and focus on those Items.

Figure 6 Example Categories of Work (items 1 thru 4 represent 87% of the costs

Cost Model

Upon receipt of the project cost information from the project team, the Value Team Leader should prepare a cost model for the project. The first step in preparation of the cost model is to review the cost information provided by the project team. The reason for reviewing cost information is to ensure that both groups agree on the unit prices, quantity of materials, and/or labor that went into preparation of the cost estimate.

If there are discrepancies in the cost, these should be identified early to avoid confusion or misunderstanding during the implementation phase of the project.

To construct the cost model, the Value Team Leader and/or the estimator on the Value Study Team distributes cost by major items of work. This helps the value team at the beginning of the Value Study to know where the major costs are to be found.



Figure 7 Example Pareto

Pre-Workshop Checklist

The following areas or causes of high cost, which may indicate poor value, and should receive the majority of the VE effort:

- Great complexity in the design. Generally, the more complex the design, the more opportunity there is to improve value and performance.
- Advancement in the state-of-the-art. Those aspects of design that reach beyond the state-of-the-art may offer potential VE savings.
- High degree of time compression in the design cycle. A project having an accelerated design program can contain elements that are over designed.
- A component or material that is critical, exotic, hard-to-get or expensive.
- Components which appear to be difficult to construct.
- Architectural embellishment.
- Record seeking design (longest span, highest piers, deepest cut, etc.)
- Large safety factors.
- Specially designed components which appear to be similar to low-cost off-the shelf items.
- Components which include non-standard fasteners, bearings, grades and sizes.
- Sole-source materials or equipment.
- Processes or components which require highly-skilled or time-consuming labor.
- Items with poor service or cost history.
- Items that have maintenance and field operation problems.
- Project costs that exceed the amount budgeted.
- Constructability for example, Sequence of work, coordination with other projects, work site accessibility, etc.

Will a change to the existing method solve any problems or have any benefits other than cost, in such areas as?

✓ Noise

✓ Quality

- ✓ Safety
- ✓ Maintainability
- ✓ Time

✓ Energy Use

✓ Performance

- - ✓ Reliability
 - ✓ Weight
 - ✓ Vibration
- ✓ Water Quality

✓ Fire Protection

✓ Air Quality

✓ Aesthetics ✓ Production Rate

✓ Standardization

- ✓ Simplification

Chapter 3 – Workshop Activities Teamwork

Introduction

So, you've been asked to be on a member of the VE Team on a Value Study. Now is the time to ask yourself, "Do I have what it takes?"

To be a team member on a Value Study, you need to do more than just show up and contribute your ideas. You must also take a certain amount of responsibility for the outcome and ultimate success of the study. Yes, the Value Team Leader, and/or facilitator, is held accountable for the results of team, but the Value Study Team members are truly responsible for the success of the study.

This might be a major change in role definition for most Value Study Team members and for many Value Team Leaders as well. As a Value Study Team member, you can't sit back and be a spectator. You must be a full-time participant, actively contributing during all phases of the VE job plan. On top of this, you need to observe the dynamics of the team and intervene when other team members are behaving in ways that are possibly detrimental to the team. No one said it would be easy (and it's not), but it is definitely part of your responsibility as a Value Study Team member.

If you view most Value Studies as an event that someone else plans and leads and you are just along for the ride, then this won't be an easy adjustment to you to make. And if your Value Team Leader is accustomed to being in total command, the adjustment will be even more difficult. Don't expect to feel at ease right away with this additional responsibility. It's like when you first learn how to drive. You can't just sit back and enjoy the view. This is a full time job and it takes a lot of energy.

Content & Dynamics

There are two central points that will require a Value Study Team member's attention during the study: content and dynamics. "Content" is what the Value Study Team is working on. That could include the ideas that are brought forth during the Creativity Phase, the calculations written down during the Development Phase, or the individual functions on the FAST diagram (see chapter 4 – Function analysis).

"Dynamics" includes how your fellow Value Study Team members are working together and how the members are behaving or acting during the study.

Most of the time, the members of a Value Study Team will not be familiar with each other. The team may consist of individuals from different parts of the Region or State with variety of backgrounds and levels of experience. In many cases, it may be the first time they have had the opportunity to work together. There may be times during the Creativity or Evaluation Phase of a Value Study when you feel you can't actively participate because you're not a subject matter expert on the current function being discussed. But just because you can't contribute at that moment doesn't mean you can't be a factor.

The VE Team Leader has the "power of ignorance". The team leader is not expected to have all the answers but is expected to be able to ask all of the questions. Yes, that even means the questions might think are dumb.

Why? This can be disarming to the group and actually evoke additional discussion if it is done with humor and a spirit of comradery. Project teams often need someone to step forward and ask the questions they have been afraid to ask.

In the end the great team leader is *surrounded* by wise counsel and welcomes and invites discussion with the wise counsel. At this time, you are in an excellent position to observe the team's dynamics, and that's usually where teams need some help.

Value Study Teams typically have no problems with the content of the study; they always have the right items on the agenda and more than enough subject matter experts to handle any question that might arise. If a Value Study isn't a success, sometimes it's the result of poor team dynamics. Remember, the entire Value Study Team is responsible for the success of the study, so all members need to play an active role in facilitating in the healthy dynamics of the team. When you are not immersed in the content, you have an advantage of perspective; this allows you to watch the dynamics of the team.

So, how do you know whether a Value Study Team's dynamics are working? If the dynamics of the team are balanced between both its task and relationship needs, it will look and feel like a smooth-running ship. In fact, most team members work in ways that assist in getting the job done and at the same time make other team members feel valued, respected, included, and energized. Value Study Team members typically leave the study saying, "That was a very productive Value Study, and I enjoyed being a member of that team."

When task and/or relationship needs are out of whack, or not enough attention is being paid to one or the other, the team's dynamics can become dysfunctional just like a ship running into rough waters. If you hear members saying, "We got a lot of things accomplished, but I really don't care to work with any of those people again," it's a sure sign that the team hasn't paid enough attention to its relationship needs. And if you overheard, "We had a blast! We didn't get much done, but it was a great week," the team has slipped on the task side of things.

Learning how to observe a Value Study Team's dynamics and then stepping in at the appropriate moment takes time and practice and is not just the job of the team leader/facilitator.

Don't try to watch everything; if you do, you'll probably see nothing at all. The idea is to train your eyes and ears so that you can focus your observations.

Relationships

Personal relationships we develop on a team make a big difference in how we feel about our work and our workplace, as well as our team. However, you don't have to be best friends to be an effective Value Study Team member.

Being a Value Study Team member is about thoughtful behavior. In a sense, it's about treating a team member as if he or she were your best friend. Now, this doesn't mean socializing outside of work, or sharing intimate personal feelings; what it does include is every kind of behavior you can think of that conveys respect.

Think about the ways you demonstrate respect for your best friend. Do you offer help to your best friend when he or she needs it? Do you listen to your best friend without prejudging their ideas or opinions? Are you sensitive toward your best friend when he or she is experiencing personal problems? Do you accept your best friend's odd behaviors? Do you arrive on time for meetings with your best friend when you know it will benefit them? Do you share in your best friend's excitement and offer praise when they have achieved something?

My guess is that you answered "Yes" to all of the above questions. And I'm sure you can think of many more ways that you show respect for your best friends. That's what it takes to be a Value Study Team member too.

A meeting does not have to be 100% business. It is perfectly fine to ask team members how they are doing or what they are planning next weekend. This can really help ease tension when disagreements occur later. Of course, you should not socialize for the entire meeting.

Communication is a two-way street

Communication is the exchange and flow of information and ideas from one person to another. It involves a sender transmitting an idea to a receiver. Effective communication occurs only if the receiver understands the exact information or idea that the sender intended to transmit.

Many of the problems that occur during a Value Study on are the direct result of people failing to communicate. Lack of, or poor communication can cause good teams to break down. It leads to confusion and can cause good plans to fail.

Working on Value Study Teams can be very rewarding, but at times it can also be difficult and perhaps even frustrating. If there are poor communicators on the Value Study Team, you may often feel left in the dark, lost, or misunderstood. To create a successful Value Study Team, effective communication methods are necessary not just for Value Team Leader but for the team members too. Even though some people understand their communication skills need improving, many aren't certain how to improve them.

Communication is a two-way street, so it is important that you listen carefully to your team members when they are speaking. Don't tune speakers out or get caught in the
trap of planning ahead to what you want to say next. You may miss an important detail and, in the worst case, repeat the detail you missed because you were not listening.

Share suggestions, ideas, solutions, and concepts with your team members. Take the time to help your fellow team members, no matter what the request. You can guarantee there will be a time in the future when you'll need some assistance. And if you've helped them in past, they'll be more than happy to lend a helping hand.

If you hear something that confuses you, you should ask about it. Maybe you missed a detail or maybe you remembered something others forgot. In any case, it's important that everyone understand exactly what's going on. Chances are that if you're confused, then others are too.

If a teammate suggests something, always consider it-even if it's the silliest idea you've ever heard! Considering the team's ideas shows you're interested in other people's ideas, not just your own. And this makes you a Value Study Team member. Remember, nobody likes a know-it-all.

Look at the person who's speaking to you, nod, ask thoughtful questions, and acknowledge what's said by paraphrasing points that have been made. If you're unclear about something that's been said, ask for more information to clear up any confusion before moving on. Effective communication is a vital part of any Value Study Team, so good listening skills shouldn't ever be undervalued.

Conversely, if a team member asks you a question, you should answer it courteously. The team member may be bringing up a crucial detail that could make or break the team's plans.

And let's not forget about the Abilene Paradox. You know, that trip that no one really wanted to take, but for some reason, the group chose to take anyway. If you disagree with someone or some idea, speak up. Just do so in a constructive manner.

Team Member Participation Expectations

Pre-Study

Once selected to participate on a Value Study, each VE Team member receives a project study packet. They take it upon themselves to learn as much about the project as they can before the Value Study begins. The Value Study Team member will research similar projects prior to the study looking for ideas to bring forward during the Creativity Phase of the Value Study.

Information Phase

During the project team's presentation, the Value Study Team member is prepared to ask questions as the need arises. This isn't a one-way street. Information needs to flow between everyone involved.

Remember, you were selected to be on a Value Study because of your expertise in a particular subject matter. That said, now is the time to really dive in to the areas you are proficient in and retrieve all of the information you can find.

Are there other team members with the same body of knowledge as you? If yes, pair up with them. This is an excellent time to get to know the rest of the team. If no, do you have any needed contact numbers in case questions arise that you can't answer?

During the site visit, the team member will try and pick up as many of the small details as possible. These details will possibly lead to more questions that the Value Study Team will need answers to.

Function Analysis Phase

If a Value Study Team member has been through a Value Study before, then they start asking themselves the "What does it do?" question as they are looking though the prestudy material. A Value Study Team member will start jotting down functions before the team ever physically gets together. **What functions must the project perform?**

Creativity Phase

This is the fun part of the Job Plan. The idea, of course, is to actively participate, bringing up as many ideas as possible. When you have exhausted your ideas for the current function being explored, listen to the ideas from other team member with an objective ear. This is a perfect time to observe the group dynamics.

Evaluation Phase

Give every idea a fair shake. Some team members may be chomping at the bit to discuss one idea or another depending on their area of expertise. Remember, just because it isn't your idea, doesn't make it fatally flawed. Value Study Team members listen objectively when other team members are rating different concepts regardless of who originated the idea. Innovation is good whenever and from whomever it originates

Development Phase

On the off chance that your concept made it this far, then it's time to sharpen your pencil and get to work. Don't be afraid to ask for assistance from other team members. If your idea(s) didn't make it through the Evaluation Phase, then chip in up and volunteer to help another team member develop their idea.

Make sure your write-up is clearly written. In the end, you want someone that knows nothing at all about the project to be able to understand it. Remember that the Value Study report goes to individuals that aren't necessarily a subject matter expert like you.

Presentation Phase

This is the time to "sell" the Value Study Team's recommendations. Most engineers and technicians prefer not to stand up in front of a group to "sell" their ideas. If you like to, then you can assist the team leader during this phase. If the idea was yours, you can do a better job of delivering the idea than the rest of the team.

Post-Study

The Value Study isn't finished when everyone packs their bags and heads for home. If your concepts were pushed forward into recommendations, it's a good idea to check in with the Value Team Leader from time to time to see how the implementation of those recommendations is going. Perhaps your assistance will be needed to further clarify or develop your ideas.

Value Study Ground Rules

A Value Study follows a prescribed process, which has been proven over many years to produce the best results. This process needs the team members to be fully engaged in the study during the week.

In order to maintain the schedule and provide the best results to the project team, its best if all team members follow some basic ground rules during every Value Study:

- 1. Be prepared and attend the entire study. You were selected to assist on this team based on your expertise in the subject matter. If you cannot be in attendance for the entire time, then please contact the Value Team Leader at least one week prior to the study so the appropriate arrangements can be made. Perhaps another subject matter expert can be found, or being able to reach you by phone during the course of the study will be sufficient. When team members leave partway through the study, or come and go frequently, the rest of the Value Study Team can lose its momentum and cohesiveness.
- 2. Turn off your cell phones and other electronics during the study. Unless it is information to assist the team, please try to wait until breaks to return phone calls, check on messages, or sort through e-mails.

- 3. No dress code. Let's be comfortable. The first day typically includes a site visit, so please have the appropriate footwear. The project office will supply hard hats and/or safety vests as appropriate. The rest of the week the dress code is what some would call business casual (no ties required). The final day of the study, the team will give a presentation to the project office and perhaps some of the various stakeholders too. You may want to wear a tie on this day, but again, it's optional.
- 4. If you have a laptop, bring it along. Most Value Study Team members are more comfortable developing their write-ups on a computer. The facility hosting the study may not always have network connections, etc., so often times a memory stick or email is the network of choice to share files. Note: proprietary information or information that is not intended for wide circulation must be managed through appropriate document control protocols.
- 5. The Value Study Team's success will be evaluated based on the level of contribution that we bring to the project. Remember that the goal of a Value Study is to "add value" to the project; saving money is just a by-product. We want to make recommendations based on solid engineering judgment that will result in an improved overall project.

Team Members' Responsibilities

The SAVE "Value Standard and Body of Knowledge" has an excellent list of team members' responsibilities.

- 1. Keep accurate notes as assigned by team leader.
- 2. Consult with the Value Team Leader on any problem that may handicap progress.
- **3.** Show respect through timely attendance.
- 4. Share workload equally whenever possible.
- 5. Be willing to admit if you don't know something; but strive to get the answer. Don't be afraid to make mistakes.
- 6. Stay focused, avoid tangents, follow the basic problem-solving steps, and get help from Value Team Leader on what techniques may be most suitable for the particular problem.
- 7. Don't waste time discussing whether or not a step should be used; do it and evaluate it after the study has concluded.
- 8. Understand the approach being taught and its purpose, including the reason for each step and the technique being applied.

- 9. Do the job together as a team. Don't force individual solutions-sell them! Remember, there can be more than one solution to a problem.
- **10.** Be a good listener; don't cut people off and don't second guess what other people are going to say and what they are thinking.
- **11.** Bring all data that bears on the problem, some are objective, some are subjective. Keep an open mind and don't be a roadblock.
- **12.** Be enthusiastic about the project and what it is that you are doing.
- 13. Do not attempt to take over as a team leader-be as helpful as possible. Remember, the leader already has difficult job in trying to guide, control and coordinate the overall effort.

The Role of the Value Study Leader

Working with people is the most important thing one does in any job. The way the team members conduct themselves in dealing with others is an element in the success or failure of the study. People at all levels in an organization are involved in the total VE effort. For the VE program to be successful, these people must not only offer their cooperation, but must become a part of the dynamic and creative spirit that is basic to VE.

Maintaining good human relations is essential for the Value Team Leader. By the very nature of your job, you will be challenging their answers and questioning their ideas. You will be critical of the status quo and seeking to make constructive changes.

There are three types of interactions between people involved in a Value Study which are important to consider:

- 1. Relations between members of the Value Study Team, which is usually composed of people from a number of different disciplines with differing viewpoints.
- 2. Contacts between members of the Value Study Team and their sources of information; e.g., design engineers, estimators, construction engineers, users, etc.
- 3. Contacts with persons who have the authority to approve or disapprove the changes recommended by the Value Study Team.

Principles of Social Behavior

Development of favorable attitudes for and acceptance of, a new concept occur over a long period of time. Each team member can make an important contribution toward gaining enthusiastic acceptance of VE in his organization by following the general principles of social behavior described below.

Empathy

In all dealings with other people, it is helpful to practice empathy: Placing oneself in the shoes of others, and trying to view the problem as they do. Use of empathy in dealing with people requires that these questions be asked:

- What are they saying?
- What do their actions indicate?
- What do they really believe?
- Why do they believe this way, act as they do, and say what they do?
- Are they under pressure?

If one is able to answer these questions, the hurdle of understanding others will be surmountable. This use of empathy paves the way for selecting the correct approach to whatever attitude is encountered.

Honesty

In most cases, those consulted during a Value Study contribute time and technical ability to the VE effort, with no chance of praise or recognition for their contributions. For this reason, always give broad credit to contributors of a successful Value Study. When asking for help and information, admit unfamiliarity and inform the persons asked that they are doing the questioner a service; that their efforts are appreciated.

Individuality

It would be well to remember that every person is human, all with their own individual collection of ideas, habits, and ways of thinking.

Approach people as individuals and not as stereotypes. Each design is a product of a particular designer's sensitivities and preconceived ideas. The cooperation that we receive from others is dependent to a large degree on our ability to convince them that their competence is recognized.

Thoughtfulness

Regard for the feelings or circumstances of others is essential to establishing a climate where people will take an active interest in the performance of VE. Keep in mind that people have pride in their abilities and in the work they perform. It is each team member's personal job to get people to relax and lose their apprehension of those who come to them asking questions and suggesting changes. People are committed to established ways of thinking and established ways of doing things, and they don't change easily. Expecting them to adopt new ideas and philosophies in a short time is not reasonable. Patience is a vital asset if constructive results are to be realized.

Positive Thinking

Positive thinking on the part of Value Study Team members can lead to positive and dynamic actions. It is necessary that various team members be well grounded in the basic Value Methodology so that they are able to show confidence in its application. Such a positive approach must, however, be tempered by consideration of the human relations points made in the above and following paragraphs.

Tact

If you approach people with a proposal for change that affects something they did earlier, your approach should date back to the original design.

- Ask them about the background on the project
- Discuss these ideas
- Supply them with new facts and data
- Ask their opinion to see if they can come up with an alternative themselves. Their ideas may be similar to yours and, occasionally, even better.

Flexibility

In this changing world, the Value Study Team members must be flexible in their thinking so that a new idea, when injected into a proposal, will be given full consideration, and a fair decision rendered. Also, there should be recognition that circumstances do change, and that an excellent VE Proposal today might be outmoded tomorrow.

A change recommended to save money gives an indication that the old way is uneconomical or is representative of poor value. The human reaction is that the original decision-makers feel that change is a threat to their security. Security, in this case, means more than just holding a job. It means security against criticism, and protection of opportunities for advancement and increased esteem in the eyes of peers, etc.

A decision-maker tends to feel that suggested changes cast a bad reflection on the original decision. So, the reaction to the team might be a lack of cooperation or disapproval of the change.

Resistance to Change

Resistance to change may be defined as an unwillingness to consider a change. The frequency with which such resistance is encountered makes this a problem of primary importance.

Resistance to change usually occurs when the resister is trying to insulate him or her from the impact of the change. The intensity of the resistance, however; depends largely on the extent which the Value Engineer has identified and anticipated possible kinds of resistance. Some conditions which generate resistance to a proposal are as follows. Those affected by the change:

- Recognize that their personal biases are being disregarded
- See an entirely different meaning in the change
- Have had no say in developing the change
- Are torn between logic and loyalty
- Realize their vested interests are in jeopardy
- Cannot understand the nature of the change
- See no benefits to them

Promoting Cooperation

Attention to human relations must be a continuing effort. Some useful rules of conduct for the Value Study Team members to apply in their daily tasks are:

- Acquaint people with the nature and objective of the project.
- Promote VE as a team effort of the entire organization to achieve design excellence.
- Respect the chain of authority, customs of the organization, and personal characteristics of the people with whom you are working.
- Anticipate likely adverse reaction to your work.
- Make suggestions, recommendations, and requests as clear as possible at all times.
- Make reports as clear and accurate as possible.
- Never start a conversation with individuals by criticizing or belittling their work.
- Be careful in handling or making proposals which imply criticism, or affect jobs or assignments.
- Always have the facts ready to back up the proposal or report, and be able to present them clearly.
- Consult with those who are affected by proposed changes.
- Remember to listen carefully. Listen to what people say and respond to their thoughts and needs. The person who objects to a proposal may give a clue as to how it may be approved or modified so as to enable approval.
- Show respect for the other person's opinions.

Team Building

Team building refers to a wide range of activities, usually in a business context, for improving team performance. Team building is pursued via a variety of practices, and can range from simple bonding exercises to complex simulations and multi-day team building retreats designed to develop a team (including group assessment and group-dynamic games), usually falling somewhere in between. Reasons for team building include:

- Improving communication
- Making the workplace more enjoyable
- Motivating a team
- Getting to know each other
- Getting everyone "onto the same page", including goal setting
- Teaching the team self-regulation strategies
- Helping participants to learn more about themselves (strengths and weaknesses)
- Identifying and utilizing the strengths of team members
- Improving team productivity
- Practicing effective collaboration with team members

Communication Exercises

This type of team building exercise is exactly what it sounds like. Communication exercises are problem solving activities that are geared towards improving communication skills. The issues teams encounter in these exercises are solved by communicating effectively with each other.

Goal: Create an activity which highlights the importance of good communication in team performance and/or potential problems with communication.

Problem Solving/Decision Making Exercises

Problem Solving/Decision making exercises focus specifically on groups working together to solve difficult problems or make complex decisions. These exercises are some of the most common as they appear to have the most direct link to what employers want their teams to be able to do.

Goal: Give the Value Study Team a problem in which the solution is not easily apparent or requires the team to come up with a creative solution

Planning/Adaptability Exercises

These exercises focus on aspects of planning and being adaptable to change. These are important things for teams to be able to do when they are assigned complex tasks or decisions.

Goal: Show the importance of planning before implementing a solution

Trust Exercise

A trust exercise involves engaging team members in a way that will induce trust between them.

They are sometimes difficult exercises to implement as there are varying degrees of trust between individuals and varying degrees of individual comfort trusting others in general.

Goal: Create trust between team members

Conflict

Conflict can be pretty much inevitable when you work with others. People have different viewpoints and under the right set of circumstances, those differences escalate to conflict. How you handle that conflict determines whether it works to the team's advantage or contributes to its demise.

You can choose to ignore it, complain about it, blame someone for it, or try to deal with it through hints and suggestions; or you can be direct, clarify what is going on, and attempt to reach a resolution through common techniques like negotiation or compromise. It's clear that conflict has to be dealt with, but the question is how: It has to be dealt with constructively and with a plan, otherwise it's too easy to get pulled into the argument and create an even larger mess.

Conflict isn't necessarily a bad thing, though. Healthy and constructive conflict is a component of high functioning teams. Conflict arises from differences between people; the same differences that often make diverse teams more effective than those made up of people with similar experience. When people with varying viewpoints, experiences, skills, and opinions are tasked with a project or challenge, the combined *effort* can far surpass what any group of similar individual could achieve. Team members must be open to these differences and not let them rise into full-blown disputes.

Understanding and appreciating the various viewpoints involved in conflict are key factors in its resolution. These are key skills for all team members to develop. The important thing is to maintain a healthy balance of constructive difference of opinion, and avoid negative conflict that's destructive and disruptive. Getting to, and maintaining, that balance requires well-developed team skills, particularly the ability to

resolve conflict when it does happen, and the ability to keep it healthy and avoid conflict in the day-to-day course of team working.

Value Studies often address the most contentious, divisive, and emotionally charged problems within an organization. Obviously, if the people involved could work these problems out by themselves, they wouldn't go to the expense of bringing in a Value Team Leader to help.

Many rookie Value Team Leaders are petrified that the Value Study they are facilitating is going to explode into conflict and spiral out of their control. But conflict is not all bad: It indicates that people are involved and care about the issues at hand. By using techniques for managing conflict, Value Team Leaders can help the Value Study Team work through emotional and political issues and can help turn controversies into solutions. The trick is to recognize when conflict is unhealthy and unproductive and how you can turn that conflict around and use it to power a solution.

Set goals and ground rules in advance

The most important time to stop unproductive conflict is before the facilitated session starts-in the planning and goal-setting phase. Start off with these guidelines:

• Ensure that the goals of the Value Study are unambiguous and actionoriented. This will keep the workshop from drifting into unproductive areas and becoming a general gripe session.

• Establish the ground rules beforehand. This will set the Value Study's tone and communicate in an unmistakable way that personal attacks, arguments, aggression, domination, digression, sarcasm, and put-downs are off-limits. The rules also create a baseline of acceptable behavior that can be used as a touchstone to refocus the meeting if it goes astray.

• Make certain that the right people are invited to attend the Value Study. This will guarantee that the room isn't filled with folks who are not committed to the process, who are itching to get back to their regular duties, or who are resistant to the team's efforts.

All the preparation in the world, however, cannot forestall resistance and conflict within a facilitated session. Value Studies are often designed to work out disagreements and issues, of which conflict is a natural and unavoidable aspect. The question then becomes whether that conflict is healthy and productive. Many conflicts end up well, by bringing those with divergent opinions together to reach acceptable compromises that are good for the team. Others, fueled by hidden agendas, personal animosities, blame, and cynicism, can leave everyone in the room feeling unmotivated, angry, and frustrated, and will often result in a more hostile situation than existed prior to the meeting. Managing Value Studies to ensure they foster productive debate rather than counterproductive argument is one of the central roles of Value Team Leader.

Look for warning signs

When we talk about "unhealthy" activities in the Value Study, these are the kind of incidents and circumstances we're referring to:

• **Sarcasm** - Team members use a sarcastic tone of voice or roll their eyes and elbow their neighbor every time a suggestion or comment is made.

• **Argument** - Two team members engage in a separate, heated discussion, ignoring the ground rules and moving from debate into personal conflict.

• **Domination** - A team member jumps into every discussion and monopolizes the floor, preventing other team members from participating.

• **Aggression** - A team member uses aggressive body language or tone of voice to intimidate or ridicule other members.

• **Digression** - Team members can't stay focused on agenda issues and want to discuss other items that are not the focus of the session.

• **Put-downs** - Team members say "yes, but" to every suggestion that other members put forth.

• **Resistance** - Tearn members refuse to participate. These are just a few of the manifestations of conflict in the facilitation setting. In general, when open exchange turns into closed-mindedness, when listening turns into shouting, when cliques form and opinions harden, and so on, the session is veering in the wrong direction and it's time for the Value Study Leader to help the team get back on track.

Remain neutral and defuse the emotions

There are two overall guidelines that facilitators should consider when facing conflict: Remain neutral and defuse the emotions. Neutrality is the Value Team Leader's central ethical position.

A facilitator must have the emotional maturity to realize that, whatever their opinions on the merits of the discussion or the personalities of the participants, only by maintaining their neutrality do they maintain their moral authority. Once a facilitator is tempted into displaying a bias or an agenda, their ability to be effective is diluted and can be impossible to regain.

Separating the emotional content from the subject matter content is the key requirement for using conflict to generate positive results. Here are some guidelines for achieving that goal:

• **Restate the ground rules.** Remind team members that they agreed to follow certain ground rules and emphasize-in a nonjudgmental manner-the rules that you feel are being violated.

• **Highlight the session's purpose.** Remind team members that they agreed to solve a particular problem and that they have a responsibility to the organization and to the departments they represent to come to a solution that's best for the enterprise.

• **Put on the brakes.** By decelerating the action, facilitators can grab the group's attention and reassert control. Tell team members that you can't capture ideas and concepts that are shouted out in rapid succession, so ask them to repeat their arguments and points and take your time to rephrase and capture them.

• Assert your authority. Don't be afraid to play the role of a referee. Don't get embroiled in the emotional content of the argument, but don't be a passive spectator as your session goes awry, either.

• Test acceptance. If the debate is raising meaningful points, use your facilitative skills to turn them into team results. Rephrase the points and test the team members' acceptance and then work with team members to turn debate points into action plans.

• **Call time-out.** When the content of the session becomes inflammatory or controversial, refer the session participants back to the process. Call a time-out and take the pulse of the participants. Ask for feedback on the approach, the atmosphere, and the progress. Call for a short break and allow participants to step away from the inflammatory situation and get some air and breathe.

Unhealthy conflict is not just an operational hazard of the facilitation process: It is the process. Facilitation requires the shaping of divergence and discord into compromise and agreement. Those facilitators who are mature enough to avoid getting embroiled in the emotion of the moment and can lead their session participants through the thicket of personal agenda and passion toward concession and cooperation-can change the course of events within the enterprise.

Healthy conflict allows the team to address issues that stand in the way of project improvement, in this way the team is aligned to achieve positive contributions to the project. Dynamic tension that may emerge between team members can be a source of energy that leads to higher level innovation.

Remember the team is confronting the challenges of the project not the personalities of each other.

Conclusion

It is important to understand that a Value Study Team is a very powerful tool. When functioning well, Value Study Teams are highly productive and very effective. Value Study Team members working together can achieve so much more than the simple pooling of their talents and resources.

The Value Study that you are a part of is your Value Study and therefore it is your responsibility, help make it a success. Remember that Value Studies are not simply something that you got picked to participate on; they are something that you make happen as a Value Study Team member. The Value Study Team Leader may be steering the ship, but they are not solely responsible for the direction it sails. Every single team member needs to be responsible for the results and the ultimate success of the Value Study.

Attention to good human relations on the part of the Value Study Team will develop enthusiasm on the part of others which, in turn, will impart a tremendous impetus to the VE program. There may be occasions when all the best efforts of the team are unable to secure a good reception for a particular proposal. Attempting to force a proposal through runs the risk of building up permanent hostility. Don't win the battle and lose the war.

Chapter 4 – Workshop Activities Information Phase

Introduction

The objective of the Information Phase of the Job Plan is to understand the current state of the project and constraints that influenced project decisions.

This phase is intended to provide a thorough understanding of the project or process under study by an in-depth review of all of the pertinent factual data. Complete information is essential to provide the foundation upon which the entire Value Study is based. The complexity of the project, the amount of information available, and the study schedule will all impact on the level of effort devoted to the Information Phase.

Definitions

Benchmarking - The comparison of planned or actual processes, practices, and operations to other comparable organizations. It is often done to identify best practices The dimensions that are measured during benchmarking usually involve time, cost and quality.

Performance - The capacity of a project to fulfill its intended function. Factors such as operations, maintainability and environmental efficacy are some examples.

Process - A sequence of activities that delivers a project or product.

Site Visit - A visit in an official capacity to examine a project locations specific context and any challenges or opportunities that may affect the construction of the project.

Teardown Analysis - A set of techniques for examining devices and materials at the smallest constituent level.

Common Activities

Obtain project data

Gather information and key documents such as scope of work definition, drawings, specifications, reports, detailed project cost information, project schedule, etc.

Tools: Quality Function Deployment, Voice of Customer

Identify and prioritize strategic issues of concern. Further define the scope and objectives (Project Managers expectations) of the study.

Tools: SWOT (Strengths, Weaknesses, Opportunities and Threats); Project Charter Project Team presents the original and/or design concepts Perform competitive benchmarking analysis

Tools: Benchmarking, Tear Down Analysis, Pareto Analysis, Plan Sheets

Determine the study schedule; dates, times, location and other logistical needs Distribute information about the project for VE team members to review. Understand project scope, schedule, budget, costs, risk, issues, and performance requirements.

Confirm the most current project concept

Identify high-level project functions (need and purpose)

Visit site or facility

Confirm success parameters

This phase brings all team members to a common, basic level of understanding of the project, including tactical, operational, and specifics of the subject. The functional understanding establishes the base case to identify and benchmark alternatives and mismatches and set the agenda for innovation.

Project Overview

The intent of the Project Team's presentation is to communicate basic information about the project. The Value Study Team only has a few hours to get "up-to-speed" so keep the information to the point.

The meeting should be casual. Allow the Value Study Team to ask questions as they think of them. Have patience with the Value Study Team during your presentation. They are trying to learn about the project.

Visual aids are good but it isn't necessary to prepare anything special. When creating the presentation ask the question "If I was on the Value Study Team, what would I like to know?"

If there are some ideas that have been thoroughly investigated and discarded with good cause, please tell the Value Study Team, since the development and presentation of such ideas would have no value to the project.

Constraints and Controlling Decisions

When it comes to the project's constraints and controlling decisions please put everything on the table during the opening presentation. The Value Study Team must have a basic understanding of these constraints as the will have an impact on the types of ideas they will generate later on in the Value Study.

In addition to project constraints, there may be other issues that stakeholders will want the Value Study Team to consider. This information needs to solicited and recorded.

Stakeholder Issues

The project stakeholders should be interviewed during this portion of the study. Record all of their key project issues, and any project drivers that are identified during this time.

Gather All Types of Information

The Value Study Team should gather all relevant information, regardless of how disorganized or unrelated it may seem when gathered. The data should be supported by credible evidence, where possible. Where supported facts are not obtainable, the opinions of knowledgeable persons should be obtained.

The information sought is seldom found in comprehensive form in one place. The by-words for any Value Study are "Record Everything".

Information gathering may be subdivided into separate tasks and assigned to individual team members. Various types of data which may be obtained are:

- Physical data, such as shape, dimensions, material, skid resistance, color, weight, density, weather resistance, sound absorption capability, deflection resistance, and horizontal and vertical alignment.
- Methods data, about how it is operated, constructed, fabricated, developed, installed, maintained, or replaced.
- Performance data, concerning present performance requirements and actual performance needs in areas of design, operation, maintenance, safety, and utility.
- Restrictions, (relating to detailed specifications) concerning methods, performance, procedures, operations, schedule, and cost.
- Cost data, including a detailed breakdown of costs of labor, material, and markups for both construction and other elements of life cycle cost.
- Up to date and accurate data, relating to the anticipated volume or repetition of use for this project and future uses.

Obtain Information

Information should be obtained from credible sources. There are two basic principles in this area. First, is to seek information from multiple sources; and, second, to seek the best source for the information desired. Typical of the various sources from which the required information might be obtained are the following:

People Sources

Project managers, design engineers, operators, maintenance personnel, architects, contractors, fabricators, suppliers, and expert consultants.

Data Sources

Planning documents, drawings, computations, design analyses and calculations, specifications, material lists, cost estimates, schedules, A&E scope-of-work, handbooks, engineering and maintenance manuals, commercial and government standards and codes, test and maintenance reports, user feedback, catalogs, technical publications, previous study data files, management information systems, conference and symposium proceedings, and universities.

NOTE: It is important that the names, addresses, and telephone numbers of persons contacted during the course of the study be recorded and keyed to the information they supplied.

Obtain Complete, Pertinent Information

The type of data available will depend upon the status of the design in its overall life cycle, i.e., whether it is in preliminary design, final design, or under construction.

A set of design objectives and a statement of requirements may be all that is available early in a project cycle. For an older, standard design, such useful data as performance under use, maintenance characteristics, failure rates, and operational costs may be available. In addition to specific knowledge of the project, it is essential to have all relevant available information concerning the technologies involved, and to be aware of the latest applicable technical developments. The more factual information brought to bear on the problem, the more likely the possibility of a substantial cost reduction.

Work with Specifics/Facts

Get specific information about the item; generalities serve only to protect the status quo. You must work on each function individually before attempting to combine them into a single multi-functioning project. The danger inherent in a generalized statement is that if one exception can be found, the statement is proven wrong. If the recommendation depends upon a generalized statement, the validity of the entire study could be doubted.

Get all Available Costs

To make a complete analysis of any project, the total cost of the item, the cost of each component and a breakout of the cost of each design component are needed. Accurate and itemized cost estimates should be obtained for each proposed design to determine the alternative offering the greatest cost reduction.

Information Phase Checklist

General

- □ What is the item? How does it work?
- What does it do or accomplish?
- □ Why does it work?
- □ What must it do or accomplish?
- How does it relate to other systems, units, or components?
- □ Has it been determined why it is needed?

Specifications

- Have the specifications and requirements been reviewed?
- Are the specifications realistic? (That is, are all specified characteristics both necessary and sufficient?)
- □ Can specification requirements be modified or eliminated?
- □ Will a modification of the specification simplify design and construction?
- □ Are the specifications required, or are they guidelines only?
- □ What is it we really want?
- Are all performance and environmental requirements necessary and sufficient?
- Have the specifications been interpreted correctly by the planner and the designer?
- What are the desirable characteristics in respect to width, thickness, appearance, durability, installation, maintenance, testing, safety, etc.?
- □ Is a severe environmental issue involved?
- □ What special performance or operating characteristics are required?
- Have State and Federal policies, procedures and regulations been reviewed?

Engineering and Design

- Has the background history been collected?
- □ Who designed it? When?
- □ Who determined the requirements?
- Who must review a change?
- Who must approve a change?
- □ Who must approve implementation funding?
- Who must implement the change?
- □ Is the change procedure known?
- Does the design do more than required?
- What alternates were considered during design?
- Why were alternates rejected?
- Are any changes to the design planned?
- Do drawings reflect latest state-of-the art?
- How long is it designed to last with normal use (design life)?
- What is its normal use?
- □ What is the measure of life (time, cycles)?
- What are the life cycle costs?

Methods and Processes

- Can functions be combined, simplified, or eliminated?
- Are any nonfunctional or "nice to have"-only items required?
- □ How is construction performed?
- □ Why is it performed that way?
- Are there high direct labor costs?
- Are high-cost areas or items identified?
- □ What is the schedule?

Materials and Procurement

- Are special, hard-to-get, or costly materials specified?
- □ What alternate materials were considered? Why were they rejected?
- Are the materials used hazardous or difficult to handle?
- When was the material specified? Have new materials been developed that would perform the function for less cost?
- Have the present suppliers been interviewed to ascertain any problems which contribute to high costs?
- □ Have there been any delivery or quality problems?
- □ Is this a single source item?

Maintenance

- Has the item been observed in use?
- Have the people who use or maintain it been solicited for ideas?
- What is normal maintenance?
- □ What is frequency of maintenance?
- □ What is level of maintenance?
- Can the asset be easily accessed for maintenance activities?

Chapter 5 – Workshop Activities Function Analysis Phase

Introduction

The objective of the Function Analysis Phase of the Job Plan is to understand the project from a function perspective; what must the project do, rather than how the project is currently conceived. Function analysis is concerned with locating unnecessary costs and specific requirements (or other project driven characteristics) and determining the value of the project selected for study.

Definitions

Function - The original intent or purpose that a product, service or process is expected to perform. It is expressed in a two-word active verb/measurable noun structure.

Function Analysis - The process of defining, classifying and evaluating functions.

Common Activities

Identify the project functions (team format strongly encouraged) Tools: Random Function Identification

Classify project functions

Develop function models

- Tools: Function Analysis System Technique (FAST), Radon Function Identification When creating the FAST model, keep in mind, cost drivers, performance attributes and user attitudes to select value mismatched functions to focus the creativity phase
- Tools: Functional Cost Analysis (Function Matrix), Functional Performance Specification Technique Estimate worth of functions to select value-mismatched functions on which to focus the creativity phase.

Tools: Value Index (function cost/function worth)

This phase focuses the Value Study Team on validating that the project satisfies the need and objectives of the customer. It provides a more comprehensive understanding of the project by focusing on what the project does or must do rather than what it is. The team identifies value-mismatched function(s) on which to focus in order to improve the project.

Determine the Functions

A user purchases an item or service because it will provide certain functions at a cost they are willing to pay. If something does not perform as it is intended to, it is of no use to the user, and no amount of cost reduction will improve its use value.

Actions that sacrifice needed utility of an item actually reduce its value to the user. On the other hand, functions beyond those which are needed also are of little value to the user. Thus, anything less than performance of needed functions is unacceptable; anything more is unnecessary and wasteful. To achieve best value, functions must be carefully defined so that their associated costs may be determined and properly assigned.

A function is that which makes an item or service work or sell—in other words, an item's function is why the customer buys the product or service. A project is initiated to provide a needed function or functions, i.e. "Improve Mobility". It is a means to the end of providing a function, not the end itself.

In using the function approach, the value study team constantly returns to the primary reason for design and build cycles—the ultimate purpose of the project.

Customers buy a product or service because it will provide a function that satisfies their need at a cost they are willing to incur. If, as is almost always the case, they wish to minimize their total cost they must look beyond price and consider other costs— operational, maintenance and usage.

To be successful in the development of any project, the "function" must be carefully defined from the aspect of total life cycle cost so its associated costs can be properly assigned. The objective of the Value Study is to develop a design that closely approaches the established worth.

- What is it?
- What does it do?
- What must it do?
- What does it cost?
- What else would do the same job?
- What would that cost?



Defining Functions

Attempts to identify and define the function(s) of an item can often result in several descriptions of many sentences. While this method may conceivably describe the function(s) satisfactorily, it is neither concise nor workable enough for the VE approach to function. In VE, function is best expressed using two words:

Active Verb and Measurable Noun

The verb defines the action required (it may increase, support, modify, separate, remove, reduce, convey, etc.)

The noun describes what is acted upon (capacity, load, access, grade, barrier, queues, water, etc.). This noun must be measurable, or at least understood in measurable terms, because a specific value will be assigned to it in the evaluation process, when cost is related to function.

For example, the function of a water service line to a roadside rest area could be defined as "*provides service*". This service, not being readily measurable, does not enable us to seek alternatives intelligently.

On the other hand, if we define the function as "conveys water," the noun in the definition is measurable, and accepted alternatives, being dependent upon the quality and quantity of water being transported, can be determined.

Figure 8 Active Verb / Measurable Noun

VERB \rightarrow	Increase	Support	Modify	Separate	Remove	Reduce	Convey
NOUN \rightarrow	Capacity	Load	Access	Grade	Barrier	Queues	Water

A function is always expressed by a verb and noun. This two word description has several advantages:

- The description pinpoints the functions and is not cluttered with unnecessary information, thereby forcing the planner to decide what data is fundamental and should be retained and what is unimportant and should be rejected. This focuses attention on what the work item needs to do (it's function) when alternatives for providing the function are developed during the creative phase of the study.
- Possible alternative ways for providing the functions are not restricted by a preconceived solution. This is helpful in the creative phase of the value methodology job plan when the effort should not be limited to a narrow range of possible alternatives.
- Functions that repeat in the design can easily be identified and often combined or even eliminated.

• And, most importantly, these two-word definitions promote full understanding by all team members of the function the work item must provide, regardless of their knowledge, educational, and technical backgrounds.

A function is always described with a two-word definition, providing that a clear definition of the function is the end result. However, it may be beneficial at times to add an adjective that clarifies the work the function is related to.

Examples of the uses of this are:

- Improve (mainline) Operations
- Manage (detour) Traffic
- Maximize (habitat) gain

Purpose and Need

Before beginning any function analysis effort, a basic purpose and need for the project must to be understood.

For example, you need a hammer to do some work. What kind of hammer do you need to achieve the work in the most efficient manner?



Review the Purpose and Need Requirements

Purpose and Need: The intent of this tool is to aid in Carpenters in light construction and woodworking. The tool will have the ability to drive nails up to 3' in length and/or extract nails from lumber and other wood product construction materials.

Now we know we need some sort of Carpenters hammer, and we are not trying to identify <u>every</u> function - <u>every</u> type of hammer could possibly have.

Identifying Functions

Considerations in assuring proper function identification are:

• A function should be identified so as not to limit the ways in which it could be performed.

For example, consider the operation of fastening a simple nameplate to a piece of equipment. Rather than the specific instruction "screw nameplate," the function would be better identified as "*label equipment*," since attaching a nameplate with screws is only one of many ways of identifying equipment.

Nameplates can also be riveted, welded, hung, cemented or wired in place. On the other hand, the name may be etched, stenciled, or stamped on the equipment, thus entirely eliminating the need for the separate metal nameplate.

• Identification of function should concern itself with how something can be used, not just what it is.

For example, the function of a wire could be "conduct current," "fasten part," or "transfer force", depending on the designer's intent.

Consider the function of a box culvert which could be "convey water," "bridge (unstable) material," or "convey cattle". A guardrail may "impede force," "deflect force," "absorb force," "redirect traffic," or "reassure motorist"

Identifying the function in broadest possible terms provides the greatest potential for value improvement because it gives greater freedom for creatively developing alternatives. Further, it tends to overcome any preconceived ideas of the manner in which the function is to be accomplished.

Function Analysis Exercise

Identify the functions of a carpentry hammer

First we must break the hammer down into is individual components to understand the various function of the individual parts and how they contribute to the overall or "Basic Function" the hammer must provide.

Hammer Component Parts:

Head (machined, steel casting) Handle (hickory) Wedge (steel) Sealant (epoxy) Label (ink stamp) Shellac (spray applied) Assembly (labor)



Component	Verb	Νοι	
Head (machined, steel casting)	Connect (Drive)	Materials (Nails)	
	Separate (Remove)	Materials (Nails)	
	Deliver	Force	
	Transfer	Force	
	Transmit	Force	
	Apply	Force	
	Increase	Force	
	Focus	Force	
	Deflect	Force	
	Reduce	Deflection	
Handle (hickory)	Transfer	Force	
	Receive	Force	
	Create	Leverage	
	Increase	Friction	
	Transmit	Vibration	
	Reduce	Vibration	
Wedge (steel)	Connect	Components	
	Increase	Friction	
	Improve	Durability	
Sealant (epoxy)	Connect	Components	
	Ensure	Durability	
Label (ink stamp)	Identify	Brand	
Shellac (spray applied)	Resist	Oxidation	
	Enhance	Appearance	
Assembly (labor)	Connect	Components	
	Improve	Durability	
	Meet	Standards	

Figure 9 Functions of a Hammer

Classifying Functions

To understand which functions are absolutely necessary to achieve the required performance, functions are broken into 5 different classifications:

- Basic Functions
- Secondary Functions
 - Required
 - x Unwanted
- Higher Order Functions
- Lower Order Functions

Basic Functions

The basic function is the specific purpose for which something exists and answers the question "What must it do?"

Four rules that govern the selection of the basic function are:

- 1. Describes primary purpose and intent
- 2. If you can eliminate it while still achieving the primary purpose and intent it is <u>not</u> the basic function
- 3. Loss of the it will cause a loss of value
- 4. The customer must be willing to pay for it

A basic function defines a performance feature that must be attained. It reflects the primary reason for an item or system. In the case of the screwdriver, "transfer torque" would normally, be the basic function. However, if it were being used for something else, the basic function may change.

For example, if the desired application was to pry open lids of paint cans, the function would be defined in terms of the transfer of a linear force i.e. "*increase force*" rather than a rotational force. Thus, a clear understanding of the user's need is necessary if an adequate definition of the basic function is to be developed.

An item may possess more than one basic function. An example is the camper's hand ax, with a flat head for driving tent stakes, and a sharp blade for cutting firewood.

Secondary Functions

A secondary function also defines performance features of a system or item other than those that must be accomplished. It answers the question, "What else does it do?" For example, the basic function of exterior paint is "protect surface". Then a secondary function is "improve appearance".

Secondary functions support the basic function but generally exist only because of the particular design approach that has been taken to perform the basic function.

For example, a value on a radiator "restricts flow" and is necessary only because a hot water heating design was chosen, (*No value is needed with a forced air heating system*). Many times, the presence of a secondary function depends on the method chosen to achieve a basic function and, if the method to achieve the basic function is changed, the secondary function may be eliminated.

Observe that the system, as defined, must perform two basic functions. Rather than choosing the restrictive function of "ring bell," the broader term "make noise" was selected to permit greater freedom in developing alternative ways of making noise, i.e., horn, bell, siren, etc.

Higher Order Functions

Higher order functions represent the specific need that precipitates or causes the existence of the basic function(s). They describe the outcome or result of the basic function.

Lower Order Functions

Lower order functions describe functions that lie beyond the scope of the study. They describe the required inputs.

Function Analysis Exercise

Classify the Functions of the hammer

Component	Verb	Noun	Classification
Head (machined, steel casting)	Connect (Drive)	Materials (Nails)	Higher Order (need)
	Separate (Remove)	Materials (Nails)	Higher Order (need)
	Deliver	Force	Basic (purpose)
	Transfer	Force	Secondary
	Transmit	Force	Lower Order
	Apply	Force	Secondary
	Increase	Force	Secondary
	Focus	Force	Secondary
	Deflect	Force	Secondary (Unwanted)
	Reduce	Deflection	Secondary
Handle (hickory)	Transfer	Force	Basic (purpose)
	Receive	Force	Secondary
	Create	Leverage	Secondary
	Increase	Friction	Secondary
	Transmit	Vibration	Secondary (Unwanted)
	Reduce	Vibration	Secondary
Wedge (steel)	Connect	Components	Secondary
	Increase	Friction	Secondary
	Improve	Durability	Secondary
Sealant (epoxy)	Connect	Components	Secondary
	Ensure	Durability	Secondary
Label (ink stamp)	Identify	Brand	Secondary
Shellac (spray applied)	Resist	Oxidation	Secondary
	Enhance	Appearance	Secondary
Assembly (labor)	Connect	Components	Secondary
	Improve	Durability	Secondary
	Meet	Standards	Secondary

Figure 10 Function Classification

Organize Functions

In reviewing a list of verb-noun combinations you will typically see several functions stated in different ways. Through team discussion the team will organize the function into groups and begin to think of alternative solutions.

FAST Diagramming

Function Analysis System Technique (FAST) is a powerful structured tool used to identify and analyze function with intuitive logic to stimulate creative and innovative thinking. The primary objective is to improve value of functions for a given project, product, or process.

In 1964, Mr. Charles W. Bytheway developed FAST as the Value Engineering and Cost Reduction Administrator for UNIVAC. He was searching for a way to analyze, in depth, the functions of the Walleye Missile System.

The technique which he devised and refined was presented by him in 1965 to the Society of American Value Engineers (SAVE) at their National Conference in Boston.

FAST diagramming has since been used by Value Engineers throughout the world as a tool to correctly identify the interrelationship of the functions under study.

As in the case with most VE tasks, the development of a FAST diagram is best accomplished as a team effort. The interplay of different viewpoints causes deeper thinking about the subject and, therefore, more thorough investigation.



Figure 11 FAST Diagram Elements

Chapter 5 - Function Analysis Phase 60 | Page

How FAST works

The first step is to determine what the team considers to be the most general function of the item to be studied. This provides a starting point for what may resemble a game of "Dominoes." Expansion from that point occurs by asking the questions "HOW" and "WHY?"

"When we ask **HOW** we are looking for solutions and moving to lower levels of opportunity. When we ask **'WHY'** we are looking for reasons and moving to higher levels

of opportunity." By asking HOW (is this going to do it) and WHY (is it doing it), we may find that we are missing essential functions, or even that what we thought was the Basic Function (Purpose) may not be the basic or primary one after all.

Critical Function Logic Path

Functions that fall along this line are critical to the performance of the basic function. If you take one of them away, the basic function of the system cannot be satisfied. If you try taking one away and find that the basic function can still be performed, then perhaps the function removed is a supporting function, and not critical.

How and Why

To develop a FAST diagram, start with the identified "Higher Order" function and moving to the right, ask the question, "HOW' is (verb) (noun) actually accomplished, or "HOW' is it proposed to be accomplished. The question is answered, by the next function to the left. The team will make several suggestions and then decide on the most appropriate one. That answer, also expressed as a verb and a noun, is the next lower order function on the diagram.

The progression to the right is accomplished by continuing to ask "HOW" for each new function placed on the diagram. Items to the right of the Basic function are required secondary functions, i.e., required, based on the chosen design.

To verify the HOW logic, move to the Lower Order function and ask, "WHY" is it necessary to (verb) (noun)? The answer to that question should be the function in the square to the left. If the answer does not make sense you may be missing a project function.



Supporting Functions are those that happen:

- All the time,
- At the same time as
- Are caused by the critical functions.

They occur as a result of the method chosen for accomplishing the basic function. These secondary functions are positioned vertically. (WHEN direction on the Diagram)

Scope of the Study in the FAST

The FAST Diagram uses the original design as a model. As can be seen from the above discussion, the diagram can be expanded almost endlessly to the left, even to the point of asking why the project is being designed.

At some point along the critical logic path of the functions, a "SCOPE" line defines the limits of the study. To its right lies the basic function which will be the subject of the study.

The figure below illustrates an example of a FAST diagram for the case of the hammer previously shown. In the process of developing this FAST diagram, it was determined that the basic function was "Minimize Conflicts". The higher-level function was identified, and the scope of the study is shown. Also, "All the time" and "Same time" or "caused by" functions are identified.

The FAST diagram is used in the identification and visualization of high-cost functions. By tying function cost to a FAST diagram, attention can be focused on the high-cost function, or on the higher order function which makes that one necessary.

Intuitive Logic

HOW? Right to Left - Starting with the goals answers how to achieve the goals

WHY? Left to Right - Validate the intuitive logic of "HOW?"

WHEN? Up and Down - Independent Functions, supplements intuitive thinking



Figure 12 Example - FAST Diagram – Grade Separated Railroad

Focus on the Function

It is important during the Creativity Phase to concentrate on the function rather than the item itself. The use of the FAST diagram during this phase tends to draw attention away from the object and toward its function.

The preparation of a FAST diagram of, allows for a re-examination of the solution during the Development Phase. Rethinking at this time can point up areas for addition savings that may have been overlooked.

A comparison of the FAST diagram for the original design and that of the proposed alternate can be a valuable sales tool during the Presentation Phase. It has great value as a communication tool, because it is in function terms that almost everyone can understand, no matter how technical or complex the item may be.

Constructing a FAST Diagram

The basic FAST Diagram is laid out with functions along the Critical Function Logic Path



Figure 13 Constructing a FAST Diagram

Step 1 – Start by using a labeled FAST Template similar to the one shown above. You can create this template on a white board as a starting point.

Step 2 – Using Post-It[®] Notes with the functions written on them, select the function believed to be the basic function. Place this function on the function logic path the immediate right of the left scope line.

Step 3 – Evaluate whether this is the basic function by asking the question "Why" perform this function? The answer should be the higher order function place to the left of the left scope line.

Step 4 – Then continue in the how direction from the basic function by asking "How" is the basic function performed? That is the next function on the critical function logic path. Continue to the right and repeat this process until you reach the lower order function. All of the functions to the right of the basic function on the critical function logic path are required secondary functions down to the lower order function. Connect these functions with a horizontal line from the side of one function to another.

Step 4a – If two or more secondary functions are needed at the same time then utilize an "AND" gate.

Step 4b – If there are, two or more different functions (opposite ways) which could satisfy moving between one secondary function and another then utilize an "OR" gate.



Figure 14 "AND" & "OR" in the Logic Path of FAST Diagrams

Step 5 – As you develop the FAST diagram, test the validity of the critical function logic path which you have completed by starting with the lower order function and ask "Why" moving from right to left to ensure that the answer to "Why" this function is needed is the next immediate function to the right.

Step 6 – Place secondary functions which are caused by or happen at the same time as other secondary functions beneath the required secondary function where needed in the "When" direction.

Step 7 – Project or Design objectives are those secondary functions which typically relate to regulations, requirements or specifications.

Step 8 – All-the-time functions are those secondary functions that happen all the time (examples: Identify Brand or Assure Quality)

Step 9 – One-time functions are those secondary functions that only happen once. (example: Assemble Components)
Function Analysis Exercise FAST Diagram for the Carpenters Hammer

Previously, we:

- Identified the project Need
- Identified the functions of a Carpenters hammer
- Classified and organized the Functions
- •

By putting all that work together, we can develop the FAST diagram and verify our logic and that all the functions have been identified, we are not including any unnecessary functions



Assigning Cost to Functions

Another key step in function analysis is to relate cost to functions. It is useful to use a function resource matrix worksheet to assist in the application of the function/cost process. It is the cost function relationship that often vividly illustrates where unnecessary cost exists within the study project.

The procedure is:

- 1. List the functions within the scope of the project across the top of the form.
- 2. List parts, major subassemblies/sub-systems, steps of a procedure, etc. vertically on the left side of the form with their associated costs determined from the Information Phase.
- 3. Check off which functions are affected by each item/step.
- 4. Determine how much cost of each item belongs to each function
- 5. Add all columns vertically to determine how much cost is allocated to each function.

Function-cost relationships provide direction for the study team as to opportunities for greatest value improvement on a cost basis. There, of course may be other key criteria such as quality or reliability.

Function Resource Matrix Worksheet										
	Functions									
%	Component	QTY	UOM		UNIT		TOTAL	Increase Width	Separate Grades	
	Roadway					\$	-			
100%	HMA	20000	TON	\$	100.00	\$	2,000,000.00	70.00%	30.00%	
100%	CSBC	5000	TON	\$	35.00	\$	175,000.00	65.00%	35.00%	
100%	Excavation	8000	C.Y.	\$	30.00	\$	240,000.00	10.00%	90.00%	
100%	Traffic Control	1	L.S.	\$ 1	,000,000.00	\$	1,000,000.00	60.00%	40.00%	
						\$	-			
						\$	-			
						\$	-			
	Total Project Cost/Function Cost					\$	3,415,000.00	\$ 2,137,750.00	\$ 1,277,250.00	
100.0%	Function Percent of Total Cost							62.6%	37.4%	

Figure 16 Function Value Resource Matrix

See example below of how calculations from the Function Resource Matrix Worksheet could be applied to a FAST diagram to visually depict high-cost project functions.





Figure 17 FAST Diagram Grade Separated Railroad

Function Worth & Cost

Worth is the most inexpensive way to perform a function.

The establishment of the worth of a function, without considering where or how the function is used, begins after:

- All functions have been identified
- All functions are classified as basic or secondary
- All unnecessary functions have been discarded

It is perhaps the most difficult step in VE, but it is an indispensable step.

Function Worth is a highly creative endeavor because worth is a subjective rather than absolute or objective measure. Skill, knowledge, and judgment play a major role in determining the quantitative aspect of worth, in terms of dollars.

The worth of a function is usually determined by comparing the relative costs of alternate methods of performing the function. An attempt is made to find the lowest cost to perform the function.

Worth is associated with the function under consideration and not with the use of the function in the present design.

For example, consider a bolt supporting a steel beam in a bridge. The worth of the bolt is the lowest cost necessary to provide any reliable fastening to support a steel beam, and has nothing to do with the use of the beam in supporting a bridge.



Function cost is the cost of the method chosen to perform the function under consideration. Where an item serves one function, the cost of the item is the cost of the function. However, where an item serves more than one function, the cost of the item should be pro-rated to each function. The value index reflects the basic value theory that value is the relationship between cost and worth. The formula is:

Value = Function Worth / Function Cost

The goal would be to achieve a ratio of 1. This is called the Value Index.

Remember that the choice of areas to focus on must be made in alignment with the project objectives and goals. It is important to recognize the emphasis may not be on cost but rather other performance factors such as time or quality.

Function Analysis Phase Checklist

- Have all functions been listed?
- □ Have redundant functions been identified?
- Have both the required and desired functions been established?
- Have basic and secondary functions been identified?
- Are the function requirements well understood?
- Are costs assigned to each function?
- Has a worth been established for each function?
- Have target costs been determined for each function?
- Are design requirements established which do not require any function to be performed?
- □ Are function requirements exceeded?
- Are unnecessary features called for?
- □ Is there a better way to perform the function?
- Can any function be eliminated?
- Can we do without it entirely?
- Does it cost more than it is worth?
- Have all the high and unnecessary cost areas and high cost/worth ratio areas been identified?
- Does the potential cost reduction (net savings) appear to be sufficient to make further VE investigation and recommendation development worthwhile?

Chapter 6 - Creative Phase

Introduction

The objective of the Creative Phase of the Job Plan is to generate as many ideas as possible related to other ways to perform functions.

During this phase of the Job Plan, team members direct their creative effort toward the development of alternative means to accomplish the needed functions. It is important that the team achieves a clear understanding of the project through the Information and Function Analysis Phases before consideration of any alternative solutions. The Creative Phase should not begin until the project challenges are thoroughly understood.

All members of the Value Study Team need to participate and contribute to the team generating as many ideas as possible.

During this phase, every idea has merit, there should be no discussion or evaluation of the ideas put forth. This session needs to be free-flowing, allowing team members to be imaginative with their ideas.



Challenge the present method of performing a function.

Technology is changing so rapidly that the rules of a few years ago are probably obsolete. Create new ways (alternatives) for performing the necessary function(s) more efficiently and at a lower total cost. Take advantage of new products, processes, and materials.

Definitions

Brainstorming

A conference technique of solving specific problems, amassing information, stimulating creative thinking, developing new ideas, etc., by unrestrained and spontaneous participation in discussion.

Creativity

The ability to transcend traditional ideas, rules, patterns, relationships, or the like, and to create meaningful new ideas, forms, methods, interpretations, etc.

Common Activities

- Conduct creative warm-up exercises
- Establish rules that protect the creative environment being developed
 Tools: Creativity "Ground Rules"
- Employ group idea stimulation techniques
- Generate alternate ideas that may improve value.
 Tools: Brainstorming, Gordon Technique, Nominal Group Technique, TRIZ, Synetics

The team develops a broad array of ideas that provide a wide variety of possible alternative ways to perform the function(s) to improve the value of the project.

Positive and Negative Factors

The results achieved through the use of creative thinking, especially brainstorming techniques, will vary with the creative ability of the individual. However, one's creativeness can be enhanced through conscious effort toward the development of attributes such as those listed below:

Observation - Being alert and aware of conditions that exist.
Problem Sensitivity - Being able to recognize when there is a problem.
Constructive Discontent - Having a questioning attitude.
Motivation - Being willing to expend the time and energy to reach a given goal.

Flexibility - Being adaptive and open to change.

Originality and Resourcefulness - Being able to conceive a great number of new and unique ideas that reach beyond everyday solutions.

As there are positive factors which enhance the creative process, there are also factors which inhibit that process. Such mental blocks should be recognized and an effort made to eliminate them from one's thinking. These blocks to creativity are outlined here:

Habitual Blocks

- Continuing to use or approve "tried and true" procedures when new and better ones are available.
- Lack of a positive outlook; lack of determined effort; conformity to custom, and reliance on authority.

Perceptual Blocks

- Failure to use all the senses of observation.
- Failure to investigate the obvious.
- Difficulty in visualizing remote relationships.
- Failure to distinguish between cause and effect.

Cultural Blocks

- Need to conform to "proper" patterns, customs or methods.
- Over-emphasis on competition or on cooperation.
- The drive to be practical, above all things.
- Having confidence and faith only in reason and logic.

Emotional Blocks

- Fear of making a mistake or of appearing foolish.
- Fear of supervisors and distrust of colleagues and subordinates.
- Over-motivation to succeed quickly.
- Refusal to take any detour in reaching a goal.

Probably the single most important factor affecting one's creative accomplishments is the environment in which he must live and work. A creative atmosphere, characterized by mutual respect for one another's ability and the encouragement of individualistic thinking can spur a mind of even average expressiveness to great heights.

Use Creative Techniques

Use as many creativity techniques as necessary to get a fresh point of view. Adopt a positive mental approach to any problem. In developing ideas, allow no negative thoughts, no judicial thinking.

Concentrate on creating as many ideas as possible on how the function can be performed. After writing down all ideas, consider all possible combinations to determine the best method of performing the function.



Every attempt should be made during this phase to depart from the ordinary patterns, typical solutions, and habitual methods. Experience indicates that it is often the new, fresh, and radically different approach that uncovers the best value solution(s).

The best solution may be complete elimination of the present functions or item.

This possibility should not be overlooked. Only after determining that the function must remain should the Value Study Team look for alternative ways to perform the same function at the lowest conceivable cost. Free use of imagination is encouraged so that all possible solutions are considered.



Creative Thinking Techniques

Several techniques are available to the Value Engineer Team for use during the Creativity Phase. They may be used singularly or in combination depending on the project under study and the preferences of the team leader. Some of the more widely known and used techniques are outlined below:



Brainstorming

This creative approach is an uninhibited, conference-type, group approach, based upon the stimulation of one person's mind by another's. A typical brainstorming session consists of a group of four to eight people spontaneously producing ideas designed to solve a specific problem. The objective is to produce the greatest possible number of alternative ideas for later evaluation and development.

Rules observed during brainstorming:

- Judicial thinking must be withheld. This means controlling the natural tendency to instantaneously evaluate ideas.
- No criticism by word of mouth, tone of voice, shrug of shoulders or other forms of body language, that indicates rejection, is permitted.
- "Free-wheeling" is welcomed. The wilder the idea, the better; it is easier to tame down than to think up.
- Apply the technique of "hitchhiking" or "piggybacking" which is to expand on the ideas of others by offering many variations (synergism).
- Combination and improvement of ideas is suggested.
- Set a goal in number of ideas, or time, to force hard thinking.

The general procedure for brainstorming is as follows.

- The group has a free discussion, with the group leader only questioning and guiding and occasionally supplying problem-related information.
- All ideas are listed so that all members of the group can see as well as hear the ideas. The team may use a flip chart and markers, as sheet are filled tape them to the walls so that they are constantly in view.

BRAINWRITING



Brain Writing

As in traditional brainstorming, in Brain Writing everyone sits at a table together to simultaneously tackle a problem. The difference is that in Brain Writing each participant thinks and records ideas individually, without any verbal interaction. As we'll see, this small change results in a fundamental difference in the idea generation effectiveness.

Here are the steps in a typical Brain Writing session:

- Participants sit around a table and each one gets a sheet of paper with the same problem statement written at the top.
- At the facilitator's signal, each participant has 3 minutes to write down 3 ideas on the sheet of paper. Just like in traditional brainstorming, the ideas should always go unedited. The difference is that now they are being recorded in private. The number of ideas and duration can vary, but "three ideas every three minutes" works well.
- When time is up (or when everybody's done), each participant passes the sheet of paper to the participant to the left.
- Each participant now reads the ideas that were previously written and a new three-minute round starts. Each participant must again come up with three new ideas. Participants are free to use the ideas already on the sheet as triggers or to ignore them altogether.
- The group can agree to stop after a fixed number of rounds (such as when sheets come to a full turn around the table) or when participants feel that contributions are exhausted.
- After the idea-gathering phase is completed, the ideas are read, discussed and consolidated with the help of the facilitator, just like in traditional brainstorming.

A good group will be able to manage at least a half-dozen passes. Everyone's paper is then collected and can be combined into a single list of ideas-all duplicates should have been crossed out during the session. The facilitator may want to write down the "surviving" ideas on a flip chart or whiteboard as the process evolves.

A variation on this technique has everyone, using Post-it notes or small cards, write down their ideas, and place them in the center of the table. Everyone is then free to pull out one or more of these ideas for inspiration. Team members can create new ideas, variations, or piggyback on existing ideas.



Brain Sketching

This technique is a Brain Writing technique, but you pass evolving sketches rather than growing written lists of ideas around the group. As usual with most brain-writing techniques, only limited facilitation skill is needed

- •
- A group of 4-8 people sit around a table, or in a circle of chairs. They need to be far enough apart to have some privacy. The problem statement is agreed, and discussed until understood.
- Each participant privately draws one or more sketches (each on separate sheets of paper) of how it might be solved, passing each sketch on to the person on their right when it is finished. The facilitator suggests that sketches should not take more than 5 minutes or so to draw.
- Participants take the sketches passed on to them and either develop or annotate them, or use them to stimulate new sketches of their own, passing the amended original and/or any new sketches on to their neighbor when ready.
- After the process has been running for a suitable period and/or energy is running lower, the sketches are collected in.
- It will probably help to display all the sketches and to discuss them in turn for clarification and comment.
- Then move on to any appropriate evaluation and selection process.
- This method allows people to think visually, which is often more effective for design related projects.

Creative Phase Checklist

- □ Have creative thinking techniques been used?
- □ Has an atmosphere been provided that encourages and welcomes new ideas?
- □ Has there been cross-inspiration?
- □ Have all members of the team participated?
- Has an output goal been set?
- Have all the ideas been recorded?
- Have negative responses been discouraged?
- Has the team reached for a large quantity of ideas?
- Have ideas been generated without all the constraints of specifications and system requirements
- Has a thorough search been conducted for other items which are similar in at least one significant characteristic to the study item?
- Have all basic functions been identified for this project?
- Is a separate Creative Phase worksheet available to be filled out for each basic function description?
- Have you dismissed from your thoughts the present way the basic function is accomplished?
- For group brainstorming, have the techniques, method of approach, and "ground rules" been explained before proceeding?
- Have you provided for a sufficient incubation period to permit later addition of more ideas?
- Have you made provisions for a later follow-up session to evaluate and refine the ideas?
- Have all of the basic functions of the project team been subjected to the complete Creative Phase?

Chapter 7 – Workshop Activities Evaluation Phase

Introduction

The objective of the Evaluation Phase of the Job Plan is to reduce the quantity of creative ideas to a short list of ideas with the greatest potential to improve the project.

During the Creative Phase, a conscious effort was made to prohibit any judicial thinking so as not to inhibit the creative process. Now, in the Evaluation Phase, the ideas produced are critically appraised.

With all ideas recorded, the team evaluates, the ideas for acceptance based on performance information from the Information Phase, and functional requirements determined in the Function Analysis Phase.

Definitions

Evaluate - To judge or determine the significance, worth, or quality of.

Screen - To select, reject, consider, or group (people, objects, ideas, etc.) by examining systematically.

Life Cycle Cost - The sum of all development acquisition, production or construction, operation, maintenance, use, and disposal costs for a product or project over a specified period of time.

Risk - uncertainty that affects project objectives.

Quality² - The degree to which a set of inherent characteristic fulfills requirements. (² PMBOK 6th Edition 2018)

Value Methodology Alternative - An alternative or alternatives prepared by the value study team and presented to management to provide financial and/or performance improvements and which is within acceptable terms and conditions of the Value Study.

Common Activities

- Clarify and categorize each idea to develop a shared understanding
- Discuss how ideas affect project cost, and performance parameters.

Tools: T- Charts

• Select and prioritize ideas for further development

Tools: Comparison, Paired Comparison, Advantages & Disadvantages, Life Cycle Costing, Idea Criteria

• Explain how ideas are to be written as stand-alone risk-reward investment proposals.

The team produces a focused list of concepts that warrant quality time to develop into value-based solutions that can be implemented into a project or a project feature.

Key Questions

The Strategic questions listed below, are used as the basis for a set of evaluation criteria. Use these questions to evaluate the ideas.

- How does this idea work?
- Will it work for this project?
- What is the cost?
- Will each idea perform the basic function?
- Which is the least expensive?
- Will it work with modifications?
- Will it work better if combined with another idea?
- What are the chances for implementation?
- Will it be relatively difficult or easy to make the change?
- Will the users' needs be satisfied?
- What is the savings potential, including life cycle costs?

Evaluation Techniques

When evaluating ideas, the first screening, is against the project requirements. If the idea does not meet the basic requirements of the project and the Value Study Team does not want to challenge that requirement the idea is dropped, or moved to a Design Consideration.

Comparison

This technique is a method of comparing the various features of all of the alternatives under consideration.

Advantages vs. Disadvantages

In this technique, the evaluator lists the advantages and disadvantages of each alternative. The next step is to sort the ideas based on the number of advantages and disadvantages of each. Those ideas with the greatest total advantage would be chosen for further evaluation.

ldea	Advantages	Disadvantages
Recycle existing PCCP on site	 Cost Savings? Time Reduces haul off-site Reduction in Gravel Borrow and CSC 	 PH level (runoff) Physical room to recycle on-site Staging Noise

Figure 18 Evaluation - Advantages / Disadvantages

Ranking

The ranking technique allows the evaluators to assign a numerical rating to the alternates. This process might start by judging an excellent idea to be worth 3 points; a fair idea, 2 points; a poor idea, 2 points; a very poor idea, 0 point. Next, all 3-point ideas are grouped and further evaluated.

The following worksheet combines the Comparison of performance attributes along with Advantages vs. Disadvantages and the Ranking evaluation techniques together.

Figure 19 Idea Evaluation Worksheet

	IDEA EVALUATION										
	Ideas	F	Perfor	manc	e Attril	outes		Advantages	Disadvantages	RANK	
#	Function	Mainline Ops	Local Ops	Maintenanc	Construction Impacts	Environmenta I	Schedule				
	Support Load										
1	Recycle existing PCCP on site	=	=	=	~	x	=	-Cost Savings? -Time -Reduces haul off-site -Reduction in Gravel Borrow and CSBC	-PH level (runoff) -Physical room to recycle on-site -Staging -Noise	3	
2	Recycle existing PCCP in place as base	=	=	~	~	x	=	-Cost Savings? -Time -Reduces haul off-site -Reduction in CSBC	-Noise -Not able to meet x-section requirements	3	
3	Preserve existing PCCP as much as possible using dowel bars, fabric etc. and put new roadway on top	=	~	=	~	~	~	-Time -Reduces haul -Reduction CSBC	-Existing geometrics not to standard -Not able to meet x-section requirements	2	
4	Precast panel construction	=	~	=	~	=	~	-Time	-Expensive?	2	
5	Reduce the depth of the section and use continuous rebar	=	=	~	x	=	x	-More flexibility in meeting x-section requirements -Life cycle costs improve	-Longer set up time -Expensive	1	

Idea/Criteria Method

A method of graphically "weighting" ideas is useful when several are under consideration. Ideas are rated based on appropriate criteria, using a worksheet similar to that shown below. In order to illustrate, let us assume we are studying an engine manufacturing plant which produces only a 6-cylinder gasoline engine. They have discussed a large number of ideas for the new line. These have been reviewed and the options reduced to four, which are under serious consideration.

- V8 DIESEL
- V8 GASOLINE
- V6 GASOLINE
- 4-CYLINDER GASOLINE

In order to weight ideas, we need a set of standards or criteria. In arriving at a suitable set of criteria, the question is asked, "What will be affected by this idea if implemented?"

These criteria are then used to measure how well each ideas meets the required criteria. (see column heading on the top of the form as shown).

Ideas are rated against criteria by using 5 for excellent to 1 for poor.

Rate all alternatives against a criteria before moving to the next criteria. Experience in problem-solving indicates that individuals tend to rate a preferred idea high in all areas if the idea is rated against each criteria rather than the criteria being rated against each idea.

Evaluation Criteria										
Weigh Ideas 5 Excellent 4 Very Good 3 Good 2 Fair 1 Poor	Customers	Plant Equipment	Skilled Labor	Space Requirements	Vehicle Style	Productivity	Corporate Image			
Ideas								Totals		
V8 Diesel	2	2	2	2	3	2	3	16		
V8 Gasoline	4	2	2	2	3	3	3	19		
V6 Gasoline	5	3	3	4	3	3	4	25		
I-4 Gasoline	3	3	5	5	4	5	2	27		

Figure 20 Rating Alternatives against Criteria

Numerical values from left-to-right, totals are obtained and totaled in the column at the right as shown above. Figures in the "total" column are used as an aid in decision-making.

Idea/Objective Method

As a variation of the Idea/Criteria method, a set of criteria composed of "objectives" could be used. To develop our objectives, we ask, "What are the end results we would like to achieve?" We want specific, not general, goals. Objectives listed for our new engine line problem are entered across the top of the worksheet, as shown on the next page. You will note that this approach directs our thinking in such a way that a more meaningful set of standards may result.

Paired Comparison Analysis

Paired Comparison Analysis helps you to work out the importance of a number of options relative to each other. It is particularly useful where you do not have objective data to base this on.

This analysis makes it easy to choose the most important problem to solve, or select the solution that will give you the greatest advantage.

Paired Comparison Analysis helps you to set priorities where there are conflicting demands on your resources.

It is also an ideal tool for comparing "apples with oranges" – completely different options such as whether to invest in marketing, a new IT system or a new piece of machinery. These decisions are usually much harder than comparing three possible new IT systems, for example.

Follow these steps to use the technique:

- List the options you will compare. Assign a letter to each option.
- Mark the options as row and column headings on the worksheet.
- Note that the cells on the table where you will be comparing an option with itself have been blocked out there will never be a difference in these cells
- The cells on the table where you will be duplicating a comparison are also blocked out.

Within the remaining cells compare the option in the row with the one in the column. i.e where "A" and "B" intersect.

For each intersect cell, decide which of the two options is more important. Write down the letter of the more important option in the cell. Finally, consolidate the results by adding up the total of all the values for each of the options. You will convert these values into a percentage of the total score. (all scores totaled should equal 100%

In the example below, an entrepreneur is looking at ways in which they can expand their business. They have limited resources, and have determined a set of the best options:

- A Expand into overseas markets
- B Expand in home markets
- C Improve customer service
- D Improve quality

Then they compare these options, In the intersect cell, the letter of the most important option between the 2 is entered, Once all options have been evaluated and scored for importance, a total and percent of overall performance is calculated.

An example is shown in the figure below.

Performance Attribute Matrix											
						total	%				
Overseas Market	Α	A	C	А		3	30%				
Home Market		AB	С	В		2	20%				
Customer Service			С	C		4	40%				
Quality				D		1	10%				

Figure 21 Performance Attribute Matrix - Options

In this example, it is most important to improve customer service (C) and then to tackle Overseas markets (A). Quality is not a high priority - perhaps it is good already.

Paired Comparison Analysis is a good way of weighing up the relative importance of different courses of action. It is useful where priorities are not clear, or are competing in importance. The tool provides a framework for comparing each course of action against all others, and helps to show the difference in importance between factors.

Paired Comparison Analysis for Performance Criteria

Performance Attribute Matrix										
							total	%		
Mainline Operations	Α	Α	Α	А	Α		5	33%		
Local Operations		В	В	C	C		2	13%		
Maintainability			С	D	E		3	20%		
Construction Impacts				D	D		3	20%		
Environmental Impacts					E		2	13%		
							15	100%		

Figure 22 Performance Attribute Matrix

In the next example, is shown how this the Performance Analysis is used to determine the performance measure of a given VE recommendation for a project as discussed in Chapter 2

Performance Measures

The Percentage (%) or weight determined in the Performance Attribute Matrix exercise for determining the performance measures is critical for communicating the performance improvement of any given idea Recommendation.

Three figures are used in the performance measures exercise to determine if any given recommendation has a better or worse performance profile than the original concept for the project.

- Rating
- Weight
- Contribution

Rating – This number is scaled 1 – 10. The baseline (original concept) will always be entered as "5" to indicate a neutral position. The given recommendation will be scored by the team. Score lower than 5, will indicate how much lower than the baseline the recommendation performs as compared to the original concept. Scores higher than 5, indicate how much better the team feels the recommendation performs,

Weight – This is the number taken from the performance attribute matrix created for performance criteria, which indicates the overall performance importance objectives for the project.

Contribution – This number is calculated from multiplying the rating and the weight. A number is calculated for each, the Baseline and the Recommendation, the difference is the delta in performance for the recommendation.

The totals for all the performance attributes are then summed and the overall performance increase/decrease is determined for the recommendation.

See the example below:

Performance Me	easures				
VE Recommendation	on No. 1			Idea #	
Roundabout instead of cont	4				
Performance improvement of VE recommendation	n as compared to project ba	iseline			
Attributes and Rating Explanation For Recommendation	Performance	Base	eline	Recommendation	
Mainline Operations	Rating		5	7	
	Weight	33		8%	
	Contribution	1	.67	233	
Local Operations	Rating		5	7	
	Weight		13	3%	
	Contribution	67		93	
Maintainability	Rating	5		9	
	Weight		20)%	
	Contribution	1	.00	180	
Construction Impacts	Rating		5	4	
	Weight		20	.0%	
	Contribution	1	.00	80	
Environmental Impacts	Rating		5	4	
	Weight		13	8%	
	Contribution	6	67	53	
Recommendation Total Performance Scor	640				
	Net Chang	e in Per	formance	25%	

Figure 23 Weighted Performance worksheet

Life Cycle Costing

A method for assessing the total cost of facility ownership. It takes into account all costs of acquiring, owning, and disposing of a facility or system.

Life cycle costing is conducted when project alternatives that fulfill the same performance requirements, but differ with respect to initial costs and operating costs, have to be compared in order to select the one that maximizes net savings.

Definitions

Inflation - A general increase in prices and fall in the purchasing value of money

Escalation - Increase in price, especially due to inflation Discount Rate - The minimum interest rate set by the Federal Reserve for lending to other banks.

Throughout the Job Plan, the team should keep in mind that value is highest when performance is reliably achieved for minimum total cost. Thus, satisfactory performance throughout the desired life cycle of the product is essential to good value. Value Engineers looks beyond initial cost.

The costs of operation, maintenance, and disposal or replacement must also be taken into consideration. A complete life cycle cost model should include an analysis of the following items calculated in terms of present value:

Capital Cost - initial cost of construction, design, land, legal fees, etc.

Maintenance - the cost of regular maintenance patrol, repair, salaries of maintenance personnel, and maintenance contracts.

Rehabilitation/Replacement - the cost of replacing materials, equipment or other elements during the life cycle of the entire facility.

Salvage - income derived from disposal of a facility or the value of unused service life.

Miscellaneous - other factors to be considered if appropriate include:

- Finance Cost
- Denial of Use
- Lost Revenue

The life cycle cost of a bridge, highway, car, or any other item with a service life may be defined as "the total cost of ownership of the item over the service life of the item." Included in the life cycle cost would be the original manufacturing or construction cost, maintenance and repair costs over the service life, operational costs, replacement cost, cost of money, and any salvage value the item may have.



Consider these typical problems and conflicts observed in most companies:

- Project Engineering wants to minimize capital costs as the only criteria,
- Maintenance Engineering wants to minimize repair hours as the only criteria,
- Production wants to maximize uptime hours as the only criteria,
- Reliability Engineering wants to avoid failures as the only criteria,
- Accounting wants to maximize project net present value as the only criteria, and
- Shareholders want to increase stockholder wealth as the only criteria.

The Value Analysis of an item uses life cycle costing to evaluate the various alternatives considered in selecting the most cost effective item.

Time Value of Money

The time value of money serves as the foundation for all other notions in finance. It impacts business finance, consumer finance and government finance. Time value of money results from the concept of interest.

The idea is that money available at the present time is worth more than the same amount in the future due to its potential earning capacity. This core principle of finance holds that, provided money can earn interest, any amount of money is worth more the sooner it is received.

Everyone knows that money deposited in a savings account will earn interest. Because of this universal fact, we would prefer to receive money today rather than the same amount in the future.

For example, assuming a 5% interest rate, \$100 invested today will be worth \$105 in one year (\$100 multiplied by 1.05). Conversely, \$100 received one year from now is only worth \$95.24 today (\$100 divided by 1.05), assuming a 5% interest rate.

There are up to five variables in every problem. Here are some general ideas about how to identify them:

Present Value (P)

Any value that occurs at the beginning of the problem (or the beginning of a part of the problem) is a present value. The key is that the present value occurs before any other cash flows. Usually, when a present value is given, it will be surrounded by words indicating that an investment happens today.

Future Value (F)

The future value is usually the last cash flow. Obviously, it is a cash flow that occurs at some time period in the future. The future value is a single cash flow. If it occurs more than once, then it is probably an annuity payment.

Annuity Payment (A)

An annuity payment is a series of two or more equal payments that occur at regular time periods. Each payment, if taken alone, is a future value, but the key point is that the annuity payment is a recurring payment. That is, there is more than one of them in a row.

Interest Rate (i)

The interest rate is the growth rate of your money over the life of the investment. It is usually the only percentage value that is given. However, some problems will have different interest rates for different time frames. For example, problems involving retirement planning will often give pre-retirement and post-retirement interest rates. Frequently, when you are being asked to solve for the interest rate, you will be asked to find the compound annual growth rate (CAGR).

Number of Periods (n)

The number of periods is the total length of time that the investment will be held. Typically, it is given as a number of years, though it will often need to be adjusted to some other time scale. For example, if you are told that the investment pays interest quarterly (4 times per year) then you must adjust n so that it reflects the total number of quarterly (not annual) time periods.



Figure 24 Time Value of Money

Time Value for Money, Financial Values									
Name of Factor	Abbreviation	Formula							
Single Payment									
Compound Amount	CAF*	$\mathbf{F} = \mathbf{P}(1 + \mathbf{i})^{\mathbf{n}}$							
Factor									
Single Payment	P\\/F*	$\mathbf{P} = \frac{\mathbf{F}}{\mathbf{F}}$							
Present Worth Factor	1 **1	$(1 + i)^n$							
Uniform Payment Series		$(1 + i)^n - 1$							
Compound Amount	CAF	$\mathbf{F} = \mathbf{A} \frac{(\mathbf{I} + \mathbf{I}) - \mathbf{I}}{\mathbf{I}}$							
Factor		l							
Uniform Payment Series	SEE	$\Delta - F\left(\frac{i}{2}\right)$							
Sinking Fund Factor	511	$(1+i)^n - 1$							
Uniform Payment Series	CPE	$\mathbf{A} = \mathbf{P} \begin{pmatrix} \mathbf{i}(1 + \mathbf{i})^n \end{pmatrix}$							
Capital Recovery Factor	CKI	$\frac{A-F}{(1+i)^n-1}$							
Uniform Payment Series		$\mathbf{p} = \mathbf{A} \left((1+i)^n - 1 \right)$							
Present Worth Factor	ГҮҮГ	$\mathbf{r} - \mathbf{A} \left(\frac{\mathbf{i}(1+\mathbf{i})^n}{\mathbf{i}(1+\mathbf{i})^n} \right)$							

Figure 25 Time Value of Money

How the Calculations Work

Single Payment - Compound Amount Factor

Suppose that a given sum of money, P, earns interest at a rate, i, compounded annually.

F/P = (1 + i)''

This ratio is called the single payment - compound amount factor or (F/P,io/o,n)

Example: A student deposits \$1,000 in a savings account that pays interest at the rate of 6% per year, compounded annually. If all of the money is allowed to accumulate, how much money will the student have after 12 years?

F = P x (F/P, i%,ⁿ) = \$1,000(F/P,6%,12) = \$1,000(2.012) = \$2,012

The extended notation is (F/P,i%,n)

Single Payment - Present Worth Factor

The single~payment - present worth factor is the reciprocal of the single payment – compound amount factor.

 $P/F = (F/P)^{-1} = (1 + i)^{-n}$

The extended notation is (P/F,6%,12)

Example: A certain sum of money will be deposited in a savings account that pays interest at the rate of 6% per year, compounded annually. If all of the money is allowed to accumulate, how much must be deposited so that \$5,000 will have accumulated after 10 years?

 $P = F \times (P/F,i\%,n) =$ \$5,000(P/F,6%,10) = \$5,000(0.5584) = \$2,792

Uniform Series - Compound Amount Factor

Let equal amounts of money, A, be deposited in a savings account at the end of each year. If the money earns interest at the rate i, compounded annually, how much money will have accumulated after n years?

F/A=[(1+i)ⁿ-1] / i

The ratio is called the uniform series - compound amount factor with the extended notation being

(F/A,i5,n).

Example: A student plans to deposit \$600 each year into a savings account, · over a period of 10 years. If the bank pays 6% per year, compounded annually, how much money will have accumulated at the end of the 10-year period?

F = A(F/A,i%,n) =\$600(F/A,6%,10) = \$600(13.181) = \$7,909

Uniform Series - Sinking Fund Factor

The uniform series sinking fund factor is the reciprocal for the uniform series compound amount factor.

$$A/F = (F/A)^{-1} = i / [(1+i)^{n} - 1]$$

The extended notation is (A/F,i%,n)

Example: Suppose that a fixed sum of money, A, will be deposited in a savings account at the end of each year for 20 years. If the bank pays 6% per year, compounded annually, find A such that a total of \$50,000 will be accumulated at the end of the 20-year period.

A=F(A/F,i%,n)=\$50,000(A/F,6%,20)=\$50,000(0.0272)=\$1,360

Uniform Series - Capital Recovery Factor Suppose that a given sum of money, P, is deposited in a savings account where it earns interest at a rate i per year compounded annually. At the end of each year a fixed amount, A, is withdrawn. How large should A be so that the bank account will just be depleted at the end of n years?

 $A/P=[i(1+i)^n]/[(1+i)^{n-1}]=i/[1-(1+i)^{-n}]$

The ratio is called the uniform series - capital recovery factor or (A/P,i%,n)

Example: An engineer who is about to retire has accumulated \$50,000 in a savings account that pays 6% per year, compounded annually. Suppose that the engineer wishes to withdraw a fixed sum of money at the end of each year for 10 years. What is the maximum that can be withdrawn?

A= P x (A/P,i%,n) = \$50,000(A/P,6%,10) = \$50,000(0.1359) = \$6,795

Uniform Series - Present Worth Factor

The uniform series present worth factor is the reciprocal of the Uniform series capitalrecovery factor.

 $P/A = (A/P)-1 = [(1+i)^n -1] / [i(1+i)^n] = [1-(1+i)^{-n}] / i$

The extended notation is (P/A,i%,n).

Example: An engineer who is planning his retirement has decided that he will have to withdraw \$10,000 from his savings account at the end of each year. How much money must the engineer have in the bank at the start of his retirement, if his money earns 6% per year, compounded annually, and he is planning a 12-year retirement (i.e. 12 annual withdrawals)?

P = A(P/A,i%,n) = \$10,000(P/A,6%,12) = \$10,000(8.384) = \$83,840

Life Cycle Cost Example

Wood vs. PCC Railroad Ties

During the design of a new facility, two approaches for the railroad ties are being considered. The following cost estimate information was compiled:

Alternative 1- Wood Ties

Wood ties @ 24" on center	\$811,200
Replace 1/2 Wood Ties - Year 10	
Maintenance costs per year	\$15,000
Operations costs per year	\$30,000
Alternative 2 - Concrete Ties	
Concrete ties @ 30" on center	\$1,012,500
Maintenance costs per year	\$10,000
Operations costs per year	\$20,000

The owner has requested the designer to perform a life-cycle cost analysis of these situations. The economic criteria for the analysis are as follows:

Project life cycle: 20 years Discount Rate: 2% compounded annually Escalation Approach: 4% Present time: Date of occupancy Differential escalation rate are: Energy: 0% per year Maintenance/Repairs: 0% per year

What is the life-cycle cost of each of the alternatives? Which system should the designer recommend to the owner?

Project: Wood vs. PCC Railroad Ties

Discount Rate: 2%

Escalation Rate: 4%

Phase: Preliminary Engineering Economic Life: 20 Years

Figure	26 Lif	e Cycle	Calculation	Example
--------	--------	---------	-------------	---------

			Wood	Ties	PCC Ties		
Description			Estimated Costs	Present Worth	Estimated Costs	Present Worth	
Initial Costs							
Wood Ties @ 24" OC			\$811,200	\$811,200			
PCC Ties @ 30" OC					\$1,012,500	\$1,012,500	
Total Initial Costs			\$811,200	\$811,200	\$1,012,500	\$1,012,500	
Salvage/Replacement Costs	CAF 4%	PWF 2%					
Replace 1/2 ties @ Year 10	1.480		\$600,288	\$405,600			
		0.8203		\$492,416			
Total Salvage/Replacement	Costs		\$726,430	\$492,416			
Annual Costs	P	WF 2%					
Maintenance		16.351	\$15,000	\$245,265	\$10,000	\$163,510	
Operations		16.351	\$30,000	\$490,530	\$20,000	\$327,020	
Total Annual Costs			\$45,000	\$735,795	\$30,000	\$490,530	
Total Present Worth				\$1,819,766		\$1,503,030	
Total Present Worth Saving	S					(\$536,381)	

Evaluation Phase Checklist

- □ Have all ideas been reviewed?
- Has each idea been refined to see how it could be made to meet all needed functional and physical attributes?
- Have evaluation criteria been established?
- □ Has a cost estimate been made for each feasible idea?
- □ Has the implementation cost been estimated for each idea?
- □ Has the time to implement each idea been considered and estimated?
- Has each idea been rated according to relative merits regarding cost and other advantages or disadvantages?
- Can alternates be simplified to attain further performance/cost optimization?
- □ Have all the functions been reevaluated as to their need?
- Have at least three ideas been selected as the best ideas?

Chapter 8 – Development Phase

Introduction

The objective of the Development Phase of the Job Plan is to further analyze and develop the short list of ideas and develop those with merit into recommendations.

The selected ideas are developed into recommendations that are clearly written so that the owner and other project stakeholders understand the intent of the recommendation and how it benefits the project. Write-ups also identify any potential negative factors associated with the recommendation.

The recommendation should include text, sketches, diagrams, assumptions, supporting calculations, vendor information, cost comparison work sheets, and other information which may be necessary to convey the intent of the recommendation. The text should also identify other alternatives which may be enhanced or complemented by acceptance of a recommendation.

Issues addressed include: reliability, customer convenience, quality control, capital cost, O&M cost, life cycle cost, schedule, risk, availability, political ramifications, and perception.

Ideally, an action plan is developed for each recommendation. The action plan should, at a minimum, include what needs to be done, who will do it, and when it will get done.

Definitions

Development - A significant consequence or event.

Common Activities

- Compare the study conclusions to the success requirements established during the Information and Function Analysis Phases
- Prepare a written recommendation for each idea selected for further development
- Assess and allocate risk judgments and costs, where appropriate
- Conduct cost-benefit analysis
- Generate sketches and information needed to convey the concept
- Confirm that a recommendation should be further developed
- Finish initial recommendation development
- Develop an action plan to define implementation steps, dates, and responsibilities for each recommendation

The Value Study Team creates recommendations and low, medium, and high-risk scenarios and offers these recommendations to senior management as options that address the Pre-Workshop strategic objectives.

In developing ideas one should give consideration to all possible design solutions, including different products, and materials, as applicable.

Reference Materials

Develop a list of the names of specialists and suppliers who have the knowledge needed in the development of the recommendations, using references and phone communications. Some good reference materials are:

- 1. Buyer's Guides and Catalogues
 - a) Sweet's Catalogue Service Series
 - b) Standard Manuals
 - c) Means Cost Estimating Guides
- 2. Directories and Indices
 - a) Thomas Register
 - b) Business Directories
- 3. Standards and Specifications
 - a) AASHTO Standards and Specifications
 - b) ASTM Standards and Specifications
 - c) State Standards and Specifications
 - d) Technical Society Standards
- 4. Other Sources
 - a) Transportation Research Board
 - b) Handbooks of Technical Societies
 - c) Trade Magazines and House Publications
 - d) General Services Administration's Value
 - e) Personal Contacts
 - f) Society of American Value Engineers' Publications
 - g) Value Engineering and Management Digest



Consult Specialists

To obtain better value in design, one must obtain better answers to technical and construction problems through consultation with the most knowledgeable specialists available. If the functions have been defined correctly, using precise verbs and measurable nouns, the area of knowledge needed for value can be identified. For example, "support weight" would indicate that a material specialist or structural designer could contribute.

While consultation can be done by telephone or mail, it is usually more desirable to have a personal meeting with the specialists. The Value Study Team must be able to:

- Define the required functions and the cost problem
- Indicate the importance and priority of the problem
- Make the specialist a part of the project
- Direct the specialist's efforts
- Give credit for his/her contribution

Ask him/her to identify other specialists or sources of assistance. Effective use of specialists can remove many potential roadblocks.

Consult Suppliers

Encourage your suppliers to suggest alternatives, other materials, design modifications, etc., to learn from their experience. In design, don't demand unnecessarily stringent requirements "just to be on the safe side." Over-specification may be safe and easy, but it is an expensive "shortcut."

Solicit suggestions for improvement from the suppliers, and ask what there is about the design that causes high cost. In early planning, thoroughly describe the functional and technical requirements of the project, indicating those that are critical and those where some flexibility exists. Keep abreast of the services your suppliers have to offer, and maintain an up-to-date file of new services as a potential source of ideas leading to tangible dollar savings in future planning and design.

Procedures

Each alternate must be subjected to: (a) careful analysis to insure that the user's needs are satisfied; (b) a determination of technical adequacy; (c) the preparation of estimates of construction and life cycle costs; and (d) full consideration of the costs of implementation, including redesign and schedule changes.

Develop Specific Alternates

Those alternates that stand up under close technical scrutiny should be followed through to the development of specific designs and recommendations. Prepare drawings or sketches of alternate solutions to facilitate identifying problem areas remaining in the design and to detail a cost analysis. Perform a detailed cost analysis for proposed recommendations to be included in the final report.

Testing

Tests required demonstrating technical feasibility should be performed before the alternate is recommended for implementation. Often the desired tests have already been conducted by another agency. Ask for a report on those tests. If not already available, the Value Study Team may arrange for the necessary testing and evaluation involved.

Required testing should not delay approval of a recommendation when:

- (a) risk is low
- (b) consequences of less success would involve nothing more serious than less cost saving
- (c) the element being tested involves an intangible or subjective factor
- (d) the test is normal confirmation procedure after an action is taken.

Reasons for Rejecting VE Recommendations

Failure to provide adequate documentation is a major cause for recommendation rejection.

Project Adversely Affected

It is safe to assume that any approval authority will want positive assurance that the integrity of the project is maintained.

Technical Supporting Information Incomplete or Inaccurate

For an approval authority to have confidence in accepting a recommendation, all relevant technical information must be provided. Proof of previous successful use or tests supporting the change proposal should accompany it.

Cost Analysis Incomplete or Inaccurate

Credibility of cost information is of major importance. Erring on the conservative side with cost estimates tends to gain more favorable consideration than presenting inflated claims of savings.

Although approval authorities know that cost information must usually be estimated, the basis and sources of the estimates should be revealed.

Other Reasons

- There has been prior unsuccessful action to initiate or develop a similar VE recommendation.
- There is inadequate time in which to implement the recommendation.

Develop Implementation Plans

Anticipate problems relating to implementation and propose specific solutions to each. Particularly helpful in solving such problems are conferences with specialists in areas such as: inspection, environmental, legal, procurement, materials, and planning.

Develop a specific recommended course of action for each recommendation that details the steps required to implement the idea, who is to do it, and the time required.

Recommendation Examples

Two complete examples of VE Recommendations are shown on the following pages. They include all the forms in the final order in which they would appear in the report. These forms should be modified to fit the needs of the project under study.
Recommendation	No. 4
----------------	-------

Southbound I-5 to Eastbound SR 18

Baseline

Construct an auxiliary lane for I-5 southbound traffic to access SR 18.

Southbound I-5 going to westbound SR 18 will take a ramp directly to SR 18. Traffic heading to eastbound SR 18 continues via a new structure over SR 18 and then takes a loop ramp to SR 18 eastbound.

Recommendation

Eliminate the new structure and the loop ramp to SR 18 eastbound.

Advantages			Disadvan	ntage	es	
Reduces footprint Significant cost reduced Eliminates the need Provides a better transarterial street Eliminates the merge Able to utilize the for southbound loop construction imp Minimize geotechnic stability risks. Able to utilize multipl Still allows for future	tion or a bridge over SR 18 sition between freeway and point on eastbound SR 18 her westbound to ramp which lowers cts I impacts and potential e turn lanes simultaneously. expansion		Delays to eastbound SR 18 that don't occur now Eastbound SR 18 to northbound I-5 may be caug in the queue with eastbound SR 18 thru traffi es a better transition between freeway and erial street ites the merge point on eastbound SR 18 utilize the former westbound to uthbound loop ramp which lowers nstruction impacts ze geotechnical impacts and potential bility risks. utilize multiple turn lanes simultaneously. ows for future expansion		at don't occur now nd I-5 may be caught nd SR 18 thru traffic	
Summary of Cos			/Schedule	Ana	alysis	
		Cost			Sc	hedule
Baseline	\$3.74 M					
Recommendation	\$0.36 M	\$0.36 M				
Difference	\$3.38 M x 100%	\$3.38 M x 100% markup = \$6.76 M				
	F	HWA Func	tional Ber	nefit		
Safety	Operations	Enviro	nment	C	Construction	Other
\checkmark	\checkmark	✓	/		\checkmark	✓

IDEA NO. MA-17

Recommendation No. 4

IDEA NO. MA-17

Southbound I-5 to Eastbound SR 18

Comments/Justification

This option is part of an overall strategy to reduce project costs significantly enough to make funding the project viable in the near future in order to realize operational benefits immediately while preserving the full build-out option (baseline) at a future date if deemed necessary. The primary cost savings of this recommendation is the elimination of the proposed new structure over SR 18 to access the loop ramp and the elimination of the loop ramp itself.

The green in Figure 18 represents the existing ramp configuration.



Figure 18 – I-5/SR 18 Interchange

Southbound I-5 traffic heading to either eastbound or westbound SR 18 will take a single ramp that roughly follows the existing southbound I-5 to westbound SR 18 off-ramp as shown in Figure 18. The ramp terminal will be a signal controlled intersection with westbound traffic turning right onto SR 18 and eastbound traffic turning left onto SR 18.

Recommendation No. 4	IDEA NO.
Southbound I-5 to Eastbound SR 18	MA-17

Since the new structure over SR 18 is eliminated with this recommendation, conflicts between construction activities and existing traffic are significantly reduced. This will result in a significant reduction in required traffic control (may potentially reduce overall project traffic control costs by 50%). This recommendation virtually eliminates all potential conflicts between construction activities and existing I-5 southbound traffic. All required construction access for this recommendation can be done from SR 18 at the loop ramp that was previously abandoned during Stage 1.

Also, because the structure work is being eliminated and this recommendation requires only grading, paving, and signals, the newly proposed ramp can be constructed and operational in the first construction season.

Construction of the most recent widening of the I-5 structure over SR 18 experienced some issues related to geotechnical stability and excess water. By eliminating the new structure, any potential for these geotechnical/water problems is also eliminated.

Much of the grade of the new ramp either follows the existing westbound SR 18 off-ramp or follows the grade of the previously abandoned loop ramp for SR 18 eastbound to I-5 southbound that was replaced by a flyover ramp in Stage 1 of this interchange reconstruction project. Because the proposed ramp follows previous or existing roadbeds and does not require access to undisturbed areas, the impact to environmentally sensitive areas is reduced and the likelihood of subgrade problems during grade construction is significantly reduced.

An additional benefit of locating the ramp terminal at this location is the significant amount of width fronting SR 18 allows multiple turn lanes in both directions in order to move I-5 southbound to SR 18 eastbound/westbound traffic simultaneously in both directions. This will minimize the number of signal phases required and will reduce the amount of green time required to clear the ramp queues.

One of the additional benefits of this recommendation is the transition of SR 18 from arterial-to-freeway is relocated from its current location at South 348th Street to the newly proposed ramp terminal. By relocating the arterial-to-freeway transition to the end of the freeway ramp terminal, this is more consistent with current statewide conditions.

Also, since the loop ramp for SR 18 eastbound is being eliminated, the merging condition for SR 18 eastbound ramp traffic with eastbound SR 18 through traffic is also being eliminated.

Although the structure and loop ramp are being eliminated as part of this recommendation, the proposed condition allows for construction of the original baseline condition with a minimal amount of throw away construction.

Finally, although this recommendation is believed to be operationally viable, if for some reason the single ramp condition will not function to an acceptable level of service, the project team should strongly consider widening the existing I-5 structure over SR 18 in lieu of constructing a completely new structure.

Recommendation No. 4	
Southbound I-5 to Eastbound SR 18	

Assumptions/Calculations

A combined ramp can handle traffic volumes:

PM Peak traffic volumes controlled:

1,330 VPH southbound I-5 to westbound SR 18

1,150 VPH southbound I-5 to eastbound SR 18

Eastbound SR 18 to northbound I-5 fly-over appears to be controlling AM Peak, which should reduce conflicts with the PM Peak for the ramp traffic.

Recommended Savings

- Savings From Elimination of Structure: \$2.89 Million
- Reduction of Overall Project Traffic Control: Reduction of approx. 50% of total project traffic control = 50% x \$1.08 Million = \$0.54 M
- Reduction in required asphalt paving: (1,000' ramp x 32' width x 1' depth)/27 x 2.05 tons/CY = 2,430 tons of HMA @ \$76/ton = \$184,680 savings
- Reduction in required guardrail (includes end treatments): 1,000 LF x \$40/foot = \$40,000 savings
- Reduction in required gravel borrow: (1,000' long x 40' wide x 5' depth)/27 = 7,407 CY @ \$12/cy = \$88,884 savings

Summary of savings: \$2.89 M (structure) + \$0.54 M (traffic control) + \$0.18 M (HMA) + \$0.04 M (guardrail) + \$0.09 M (gravel borrow) = \$3.74 Million

Additional cost for the proposed combined ramp:

- Additional traffic signal: \$250,000
- Additional gravel borrow for wider ramp: (1,000' long x 14' wide x 5' deep)/27 = 2,593 CY @ \$12/cy = \$31,116
- Additional HMA for wider ramp: (1,000' long x 14' wide x 1' deep)/27 x 2.05 tons/CY = 1,063 tons HMA @ \$76/ton = additional \$80,788

Total additional cost related to recommendation = \$0.25 M (signal) + \$0.03 M (earthwork) + \$0.08 M = \$0.36 M

Total proposed savings = \$3.74 Million (savings) less \$0.36 Million (added cost) equals a total proposed savings of \$3.38 Million.

In addition assumption used in this calculation is that all necessary striping, signing, drainage, roadside restoration, clearing and grubbing and electrical requirements for the additional ramp are offset by the same requirements for the deleted loop ramp. As a result, no calculations were performed for these items.

Recommendation No. 4 Southbound I-5 to Eastbound SR 18			IDEA NO. MA-17	
Performance Measures				
Attributes and Rating Rationale for Performance Base			seline	Recommendation
Mainline Operations	Rating		5	5
Would not impact mainline I-5 operations.	Weight		2	6.7
	Contribution		133	133
Local Operations	Rating		5	5
Eliminate ramp merge to eastbound SR 18.	Weight		30.0	
May add queue delay for eastbound SR 18 to northbound I-5.	Contribution		150	150
Maintainability	Rating		5	8
Eliminates structure, guardrail/barrier	Weight		16.7	
maintenance.	Contribution		83	133
Construction Impacts	Rating		5	8
Eliminate SR 18 impacts for new structure.	Weight		6.7	
	Contribution		33	53
Environmental Impacts	Rating		5	6
Small reduction in sensitive area impacts.	Weight	20.0		0.0
	Contribution		100	120
Tota	I Performance:	į	500	590
	Net Change in	Perfo	rmance:	18%

Figure 27 Example Recommendation

Recommendation No. 7 New Ramp Terminal

Chapter 8 - Development Phase 106 | Page

			•			
Baseline						
The southbound off-r intersection of SR 16 commercial propertie	amp from I-5 to SR 1 and 356 th Street. s in order to provid	161 is curr The addition the neces	rently a one on of this ra ssary limite	e lane r amp re d acce	amp that wide quires the acq ss.	ens to 3 lanes at the juisition of 4
Recommendation						
using a roundabout a	ind connect to SR 1	I61 using a	City street			
Advantages Disadvantages						
Moves the limited access away from SR 161 It would allow the City street to remain allowing the businesses to continue to access SR 161 Roundabout ramp terminal would provide a gateway and prevent wrong way movements and a well defined transition from interstate and City street speeds Continues to provide access to WSDOT surplus property which improves the value			Added co	ay requ er and st since	non circular to	n to be slightly minimize cut and fil tersection
	Su	ummary of	Cost Ana	lysis		
	Cor	nstruction	Cost		Right-of-Way Cost	
Baseline	\$0				\$9.60 M	
Recommendation	\$0.80 M	\$0.80 M			\$1.44 M	
Difference	(\$0.80 M) x 100	(\$0.80 M) x 100% markup = (\$1.60 M)				\$8.16 M
FHWA Functional Benefit						
	F	HWA Fund	ctional Ber	nefit		
Safety	F Operations	HWA Fund Enviro	tional Ber	nefit Co	nstruction	Other

IDEA NO.

Recommendation No. 7 New Ramp Terminal

Comments/Justification

If this is a Design Build project, efficiencies will be realized in a bigger design effort that involves I-5 ramps, etc.

Based on a ramp terminal roundabout example in Thurston County on size and placement and serving as a transition roundabout from a higher speed to lower speed facility, an ICD would be in the 100 to 125' range and serve the design vehicle and business property to the north.



Figure 22 – VE/PD Relocated Ramp Terminal

Shifting the ramp terminal will allow the limited access to terminate east of SR 161, and may eliminate a large portion of the property acquisition along SR 161.

The roundabout for the ramp terminal can be constructed on the existing WSDOT right-of-way acquired during Stage 1 of this project.

Recommendation No. 7 New Ramp Terminal	I	DEA NO. C-32	
Assumptions/Calculations			
Based upon previously constructed one lane roundabo construction cost of this roundabout is \$0.80 million.	uts with no right-	of-way acquisitio	on, the estimated
The costs for the reconstructed portion of 356 th betwee included in the provided estimate.	n SR 161 and the	e new ramp tern	ninal are already
The right-of-way needed at the intersection of the base recommended ramp terminal would not require and righ control. Assume 15% of the cost of the baseline right-	line ramp termina nt-of-way only the of-way need or \$	al is \$9.60 millio e purchase of so 1.44 million.	n. The VE/PD ome access
Performance Measures			
Attributes and Rating Rationale for Recommendation	Performance	Baseline	Recommendation
Mainline Operations	Rating	5	6
This recommendation will slow the ramp traffic	Weight	2	6.7
Street allowing it to function better	Contribution	133	160
Local Operations	Rating	5	8
Moving the ramp terminal to the east will allow the	Weight	3	0.0
providing access to local businesses	Contribution	150	240
Maintainability	Rating	5	7
WSDOT will not be responsible for maintenance	Weight	1	6.7
and operation of the intersection	Contribution	83	117
Construction Impacts	Rating	5	5
No change to baseline	Weight	(6.7
	Contribution	33	33
Environmental Impacts	Rating	5	8
Reduces right-of-way acquisitions and impacts to	Weight	2	0.0
businesses	Contribution	100	160
Total Performance: 500 710			
	Net Change in	Performance:	42%

Figure 28 Example Recommendation 2

Development Phase Checklist

- Have the steps required to "sell" the ideas been planned?
- Has the time required for engineering/drawing changes been determined?
- Has it been determined when the change can reasonably be incorporated?
- Have the user's needs been satisfied?
- Is all supporting data available?
- □ Are the operational requirements met?
- □ Are the safety requirements met?
- □ Are the maintenance requirements met?
- □ Has an estimate been made of the life cycle costs?
- Have the best ideas been thoroughly described?
- Have the type of people who can help support or develop the VE recommendation been identified?
- Have ideas been solicited and recorded from specialists?
- Have all available solutions been considered?
 - Traffic Operations
 - o Structures
 - o Geotechnical
 - o Legal
 - o Location
 - o Design
 - o Maintenance
 - o Environment
- Have locally available materials been considered?
- Have you double-checked the quantities and costs used in your calculations?
- Have you developed the estimated net savings?
- Have you selected your first choice?
- Do you also have other alternates to propose?
- Does your recommendation present all the facts, clearly, concisely, and convincingly?
- Have the alternates been examined for environmental impact?
- Have appropriate organization and outside specialists been consulted?

- Have all the other organizational functions been made a part of the team and consulted?
 - o Planning
 - o Right of Way
 - \circ Construction
 - o Procurement
- Does the design make use of available standards?
- Has the new method or design been reviewed with all those concerned or responsible?
- □ Has a strong attempt been made to overcome roadblocks?
- □ Is additional information required?
- □ Have all the best reference materials been consulted?

Chapter 9 – Presentation Phase

Introduction

The objective of the Presentation Phase of the Job Plan is to present recommendations to management team and other project stakeholders or decision makers.



Definitions

Recommendation or Proposal - The act of offering or suggesting something for acceptance, adoption, or performance. A plan or scheme proposed.

Value Management - The application of value methodology by an organization to achieve strategic value improvement.

Common Activities

- Prepare presentation and supporting documentation
- Compare the study conclusions to the success requirements established during the Information and Function Analysis Phases
- Offer to management "risk-reward" innovation scenarios to select value alternatives for implementation
- Exchange information with the project team
- Ensure management has full and objective information upon which they can make decisions
- Outline an anticipated implementation plan
- Prepare formal report

Common Value Study products include a briefing document, risk analysis; cost vs. worth comparisons; Present worth analysis; advantages vs. disadvantages.

VE Recommendation or Proposal

A VE recommendation is a challenge to the "status quo" of any organization. It is a recommendation for beneficial change. The success of an individual Value Study is measured by the savings achieved from implemented recommendations. Regardless of the merits of the recommendation, the net benefit is zero if the recommendations are not implemented.

Presenting a recommendation, and subsequently guiding it to implementation, often requires more effort than its actual generation.

The initial presentation of the recommendation must be concise, factual, accurate, and presented in such a manner as to create a desire on the part of those responsible to implement the change.

The selling of the recommendation depends to a large extent on the use of good human relations. The recommendation should be presented in such a way as to avoid any personal loss or embarrassment to those related to the study item. Proper credit should be given to those who contributed and to those responsible for implementation.

The information contained in the recommendation will determine whether it will be accepted or rejected. Although sufficient information may be available to the team, unless this information is documented in the recommendation, undoubtedly, the change will be rejected.

Management must base its judgment on the documentation submitted with a recommendation. The recommendation and supporting documentation should provide all of the data the reviewer will need to reach a decision.

Value Study Report

A workbook is compiled throughout the life of a study, starting with the Information Phase. If properly maintained during the project, the workbook should require no additional preparation effort during this phase. It should be a complete and ready document to facilitate preparation of the report and support the team's recommendations.

The following list indicates the type of information that should be recorded in the project workbook for each project:

- Identification of the project.
- A brief summary of the problem.
- An explanation of why this project was selected for study.
- A functional evaluation of the process or procedure under study.
- All information gathered by the group relative to the item under study.
- A complete list of all the ideas considered.
- An explanation of all logical ideas investigated, with reasons why they were not developed further.
- Technical data supporting the idea(s) selected, with other factual information to assure selection of the most favorable idea(s).
- Original costs, cost of implementing the ideas being proposed, and cost data supporting all savings being claimed
- Acknowledgment of contributions made by others to the study.

Written Reports

Clear communications should be the basic function of all writing. No matter what the purpose of the writing, the result should be the transfer of thought. The idea you have may be top-rate, but until you've explained it clearly to others, neither your organization nor you will gain from it.

One of the ways to improve upon your written reports is to observe these ten (10) rules of clear writing:

- Keep sentences short. Long sentences make reading difficult. Time and Readers Digest usually average 16 or 17 words per sentence. Business sentences often exceed 25 words.
- Present simple thoughts and expressions.
- Use familiar words.
- Avoid using unnecessary words.
- Put action in your verbs.
- Write the way you speak. The written word sometimes gets "stuffy."
- Use terms your reader can picture.
- Write within your reader's experience.
- Use variety in expressions.
- Write to express; not impress.

Oral Presentation

The oral presentation is the keystone to selling a recommendation. It gives the Value Study Team a chance to ensure that the written recommendation is correctly understood, and that proper communication exists. Effectiveness of the presentation will be enhanced if:

- The entire team is present and is introduced
- A maximum of two to three minutes per recommendation should be the limit. Questions allowed during the presentation of each of the recommendations should be only those for clarification. All other questions should be saved for the question and answer period after the complete presentation has been given.
- The presentation is illustrated through the use of examples, models, on screen presentation, or flip charts.
- The team is prepared with sufficient backup material to answer all questions during the presentation.

The oral presentation should include, but not necessarily be limited to, the following:

- Identification of the project studied
- Brief summary of the problem
- Description of original design
- Cost of original design
- Results of the Function Analysis
- Technical data supporting selection of the recommendation(s)
- Cost data supporting the recommendation(s)
- Explanation of advantages and disadvantages and reasons for accepting the recommendation(s)
- Sketches of before-and-after design, clearly depicting proposed changes. (Drawings marked to show proposed changes are acceptable)
- Problems and costs of implementation
- Estimated net savings and performance improvement
- Acknowledgment of contribution by others
- A summary statement, which may suggest a meeting to discuss the recommendation further

Effective Oral Presentations

Remember - The group does not know the things you are presenting. If they did, there would be no point in holding the briefing.

If your audience is not thoroughly acquainted with you, be sure to introduce yourself and explain your position in making the presentation.

Identify the area of discussion. Use terms you are sure will be understood. Do not use acronyms unless they are in everyday use by the people in the audience.

Visual aids must be clear and concise with a minimum of written data. Reserve details for the oral discussion. Pictures are preferred over words on visual aids.

If you want your listeners to have and keep details, give each person a copy.

Rather than crowd, use several charts, or slides.

Keep the presentation short. You are there to give the essence of what may have taken you long hours or days to complete, and not to read charts verbatim.

Minimize the use of handouts.

Presentation Structure

Planning the Introduction. The introduction should:

- a) Establish contact between communicator and group. Exhibit personal confidence; avoid apology in manner or word. Have a good opening statement. Always make reference to related material.
- b) Arouse listener interest in the subject.
- c) Disclose the nature of the subject and clarify its objectives.
- d) Be convincing. It must satisfy the group that the subject is important to them as individuals.

II Planning the Body

- a) Realize just what it is you wish to accomplish and state this objective compellingly and enthusiastically; be brief, clear, and decisive; use specifics instead of broad, general statements. To insure clear definition of the objective, write it in the plan.
- b) The material itself may be a regulation, procedure, a report with the key points underscored, organized notes keyed to visual aids, an outline, a brief summary, or some type of digest.
- c) Organize your material logically to:
 - i) Assure more complete coverage of the subject
 - ii) Aid in arranging proper sequence for development of ideas, understanding of principles or processes, or absorption of facts
 - iii) Ensure proper consideration to each essential item eliminate irrelevant material
 - iv) Provide time control
 - v) Serve as a check for relating each step of the presentation to the objective
 - vi) Stimulate the confidence of the presenter.

III Planning the Summary

- a) Restate the objective. Some of the listeners may have become concerned with only a particular aspect of the subject and may have forgotten the objective.
- b) List or specify briefly, in sequence, the steps covered.
- c) Write out a specific closing statement. The statement should relate to the objective and leave the listeners with a feeling of having accomplished a part of their responsibility which may have been the understanding of a new idea, principle, or procedure.

Giving the Presentation

I Suggestion to Speakers

- a) Don't bluff to cover lack of knowledge. Even a well-informed speaker may get questions he can't answer. If you don't know, admit it; find the correct answer and inform the questioner, or group, later.
- b) Never use sarcasm or ridicule. They build resentment, and a resentful mind obstructs communication.
- c) Never "talk down" to the group. Help the group feel you consider yourself fortunate to have the opportunity to share your subject with them.

II Speech Techniques

- a) Get the attention of the group first. Your planning will have suggested a way to do this.
- b) Look at and talk to your listeners. The earnestness of your purpose is reflected in your maintaining eye contact with listeners, not with your notes, slides, whiteboard, or other aids.
- c) Keep your tone conversational. An effective oral presentation is not an oration. Be conversationally direct; avoid impersonal indifference in your tone. Use "you" and "we" more than "I."
- d) Be alert to audience reaction. Observe facial expressions as you progress, since they are often barometers as to whether or not you are "getting you message across."

III Platform Presence

- a) Posture and body movements can be highly expressive; free, natural, and spontaneous movements are best. Position yourself so you can see each listener and each listener can see you. Be alert, but relaxed and avoid distracting mannerisms. Discover what your distracting mannerisms are and concentrate on eliminating them.
- b) Be enthusiastic. The basis for enthusiasm is a thorough knowledge of the subject. Enthusiasm is contagious, and a physically vital delivery stimulates eager attention by the listener.

Visual Aids

Good graphic illustrations can translate a large number of figures into a simple understandable "management language." But, the documentation on which a presentation is based, and the visuals which interpret that documentation, are measured by entirely different yardsticks.

Documentation is based on detailed findings. The facts, figures and statistics which make up the documentation should be as complete, up-to-date, detailed, authentic, fully organized, and thoroughly indexed as possible.

The visuals summarize the situation at a glance. The charts, graphs or other visuals used in a presentation should be few in number and as significant, simple and free of detail as it is possible to make them

A good presentation slide should get its message across clearly in less than 30 seconds of study, and should require little explanation to enable the viewer to follow and understand it.

Gaining VE Recommendation Acceptance

Several hints which appear to be most successful in improving the probability of acceptance are discussed in the following paragraphs:

Consider the Reviewer's Needs

Use terminology appropriate to the organization and position of the reviewer. Each recommendation is normally directed toward two audiences. The first is technical, which requires sufficient detail to demonstrate the feasibility of the proposed change and the second is administrative, for whom the technical details can be summarized, while the financial implications are emphasized. Long-range effects on policies are usually more significant to the manager than to the engineer.

Progress Reports

The manager who makes an investment in a Value Study expects to receive periodic reports with estimates of potential results. These reports assure top management awareness, support, and participation in the program.

Seldom are managers motivated to act by a one-time exposure at the 'final presentation.

Early disclosure of potential changes can serve to warn the Value Study Team of any objections to the recommendation. This "early warning" will give the team an opportunity to incorporate modifications to overcome the objections. If management has been kept informed of progress, the VE recommendation presentation may be only a concise summary of final estimates, pro-and-con discussion, and perhaps formal management approval.

Relate Benefits to Organization Objectives

The recommendation that represents advancement toward some approved objective is more likely to receive favorable consideration from management. Therefore, the presentation should exploit all the advantages a recommendation may offer toward fulfilling organizational objectives and goals. The objective may be not only savings but also the attainment of some other mission-related goal of the manager.

Support the Decision Maker

The dollar yield of a recommendation is likely to be improved if it is promptly implemented. Prompt implementation in turn, is dependent upon the expeditious approval by the individuals responsible for a decision in each organizational component affected by the recommendation.

These individuals should be identified and the entire VE effort conducted under their sponsorship. Like any other well-prepared staff report, each VE recommendation should:

- a) Satisfy questions the decision-maker is likely to ask.
- b) Permit him/her to preserve their professional integrity and authority.
- c) Imply assurance that approval would enhance their image.
- d) Include sufficient documentation to warrant a favorable decision with reasonable risk factors (both technical and economic).

Adequate Return

If recommendations to management are to be given serious consideration, they should include adequate evidence of satisfactory return on the investment. Often, current contract savings alone will assure an adequate return.

In other cases, Life-Cycle or total program savings must be considered. Either way, evidence of substantial benefits will improve the acceptability of a recommendation.

Show Collateral Benefits of the Investment

Value Engineering recommendations often offer greater benefits than the immediate cost improvements specifically identified. Some of the benefits are collateral in nature, and difficult to equate in monetary terms. The likelihood of acceptance of the recommendation is improved when all its collateral benefits are clearly identified and completely described. Examples of collateral benefits are maintenance, energy conservation, aesthetics, environmental quality, replacement cost, etc.

Other Factors

- a) If the study has the approval of other authorities, cite this as an indication of broad organizational support.
- b) The use of supplementary material depends on the nature of the report. If it is long and complex, simple charts, figures, and tables may be far more effective than pages of hard-to-read values, dates, and statistics. Illustrations and photos are always a welcome relief from pages of text.
- c) Consider the procedures used by others in evaluating the recommendation. View the recommendation as others will view it.
- d) Remember that those who read the recommendation are busy; they want the facts quickly and concisely. The report must tell them all they want to know, about something with which they may not be familiar, in a clear and concise manner.

There are a number of excellent technical reasons for not implementing a recommendation. It is up to the Value Engineer to determine the real reasons.

The services of VE are often looked upon by some as an unnecessary luxury thrust upon them only to hinder them in the performance of their job. It is necessary to overcome this feeling and instill in all persons, a realization of the true value of VE service to management and a feeling of the importance of teamwork to the program.

The best recommendation ever written is a wasted effort if the recommendation is rejected by management. Herein lays the real challenge of VE. The effective Value Engineer must be able to see the "big picture"; to see the problem through the eyes of management; to be a salesman; a psychologist, an engineer, an opportunist, and a student of human nature.

Above all, Value Engineers must be sincere in their belief that the recommendations will result in improved designs at a more reasonable cost.

Presentation Checklist

- Is the need for a change clearly shown?
- □ Is the problem defined?
- □ Is the recommendation concise?
- □ Are all the pertinent facts included?
- Are dollar savings included?
- Have you double-checked your recommendations, costs, and savings?
- □ Is your information complete?
- Have you prepared back-up material for questions which may be asked?
- Can the use of a slide presentation, flip charts or whiteboard help sell your ideas?
- Has a plan of action been established which will assure implementation of a selected alternate?
- □ Is the change described?
- □ Are there pictures or sketches of before-and-after conditions?
- Have the best alternatives been fully documented?
- □ Have all the constraints been considered?
- Has the recommendation been presented to the most appropriate responsible manager or decision maker?
- □ Has the implementation plan been developed?
- □ Have the recommendations been extended to all areas of possible application?
- Has the improved Value design been considered for a standard or preferred practice?
- Has credit been given to all participants?
- If you were a decision maker, is there enough information for you to make a decision?

Chapter 10 – Implementation

Introduction

Project Managers/Project Engineers are required to determine which VE recommendations will be implemented and to sign and submit the VE recommendation approval form.

The objective of the Implementation activities of the Job Plan is to ensure accepted value alternatives are implemented and that the benefits projected by the Value Study can be realized.

Following delivery of the value study preliminary report, management and the project team should consider and agree upon the value alternatives to be implemented and then how and when the implementation will occur. In some instances, additional study and information may be required. Implementation of alternatives is the responsibility of management with assistance from the project and value teams.

Definitions

Commitment - Engagement; involvement.

Implementation - To put into effect according to or by means of a definite plan or procedure.

Investment - The investing of money or capital in order to gain profitable returns, as interest, income, or appreciation in value.

Common Activities

- Review the preliminary report
- Conduct an implementation meeting to determine the disposition of each value alternative
- Establish action plans for those alternatives accepted and document the rationale for the rejected alternatives
- Obtain commitments for implementation
- Set a timeframe for review and implementation of each value alternative
- Track value achievement resulting from implemented alternatives
- Sign off on deliverables
- Validate benefits of implemented change
- Ensure that new practices become embedded by establishing and managing an implementation plan

The project stakeholders determine what will be changed in the project as a result of the Value Study. These are changes to the original concept or base case of a study,

resulting from the value alternatives, that the project team will incorporate in future design development activities.

Implementation Investment

The need to invest time or funds in order to save money must be emphasized when submitting VE proposals. Funds or personnel time for implementation must be provided.

Successful implementation depends on placement of the necessary actions into the normal routine of business. Progress should be reviewed periodically to insure that any roadblocks which arise are overcome promptly.

Even after formal presentation, the objectives of a Value Study have not been fully attained. The recommendations must be converted into actions; therefore, those who performed the study and the manager who directed that the study be done, must all maintain an active interest until the proposal is fully incorporated into the design or plans. A poorly implemented proposal reflects discredit on all concerned. Where unexplained delays are encountered, a polite follow-up note may serve as a reminder to the responsible authority, pointing out that those who made the study are available for assistance. An approved VE proposal should not be permitted to die because of inaction in the implementation process.

Expediting Implementation

The fastest way to achieve implementation of an idea is to effectively utilize the knowledge gained by those who originated it. Whenever possible, the Value Study Team should be required to prepare initial drafts of documents necessary to revise handbooks, specifications, change orders, drawings and contract requirements. Such drafts will help to assure proper translation of the idea into action, and will serve as a baseline from which to monitor progress.

The principles of VE can be applied by anyone; e.g., a systems analyst, a shopkeeper, an engineer, an accountant, or a homemaker. Value Engineering is often considered a management tool to control costs; but, should be understood in a broader context as a problem-solving tool that anyone can use.

By definition and nature, VE is far more than a means of simply reducing existing costs. It is a tool whose strength lies in its ability to clearly delineate design alternatives and to suggest choices based on the necessity or desirability of the function, on the availability of economic means of achieving that function, and on the cost-worth relationships that assure growth and prosperity.

Value Engineering is not only one of the most effective methods available for identifying and eliminating unnecessary costs; it is equally effective when directed at the conservation of all resources, natural (energy) and human, as well as financial.

It has also proved a valuable aid in improving such areas as reliability, quality, safety, production, performance, and maintenance of schedule.

Post-Study Checklist

- Are the expected results known?
- Has someone been designated as responsible for taking action to implement the approved alternatives?
- Has the project been amended to incorporate the recommendations?
- Have the specifications or drawings been revised?
- Have completion dates for implementation been established?
- Have the resources needed to accomplish implementation been recommended and allocated?
- Have required test plans, allocations, and schedules been established?
- □ Have modifications to the VE proposal been documented?

Appendix

Appendix A Active Verb/ Measurable Noun

Active Verbs

Absorb Accommodate Actuate Add Amplify Analyze Apply Arrange Attach Attract Chanae Circulate Create Collect Combine Communicate Conduct Confirm Contain Control Convert Convey Create Decrease Demonstrate Destrov Develop Display Distribute Eliminate Fmit Enhance Evaluate Establish Expand Extend Extinguish Facilitate Fasten Filter Freeze Harden Heat Increase Improve Ignite Illuminate Impede Implement Increase

Induce Insulate Interconnect Interrupt Invert Irrigate Isolate Limit Locate Modulate Maintain Measure Minimize Monitor Move Obtain Open Position Prevent Provide Protect Purify Recommend Record Reduce Remove Repair Repel Request Resist Restrict Retain Rotate Seal Secure Select Sense Separate Shield Shorten Start Store Support Suppress Synchronize Transfer Transmit Transport Use Verify

Measurable Nouns

Acceleration Access Aesthetics Air Area Atmosphere Buildina Circuit Cold Color Comfort Communication Component Construction Contacts Contamination Convenience Current Damage Data Density Direction Distance Dust Egress Enclosure Energy Environment Equipment Expansion Flow Fluid Force Frequency Friction Gas Heat Humidity Indication Information Insulation Landscape Length Light Liquid Load Material Mixture Mobility Moisture

Motion Noise Opening Oxidation Paint Panel Parkina Personnel Power Pressure Protection Radiation Repair Resistance Rotation Rust Safety Shape Size Solid Sound Space Speed Stress **Supplies** Switch Task Temperature Texture Time Torque User Vehicle Vibration Voltaae Volume Waste Water Wear Weight

Appendix **B**

Being a Good Team Member

You were selected to assist on this team because of your experience & expertise.

- Be Committed to the success of the workshop !
- Be committed to participating for the entire duration of the workshop.
- Be Open-minded, leave preconceived ideas of what will and won't work behind.
- Review the materials provided by the Project Team prior to the workshop.
- Be Prepared to contribute.
 - Bring your laptop for researching topics, taking notes and developing
- concepts. • Communicate
 - Be a good listener allow people to say what they are thinking.
 - Contribute to discussions Share your ideas.
 - Ask for clarification when needed.
- Be Present
 - Turn your cell phone to vibrate.
 - Wait until breaks to check emails.
 - Refrain from side discussions during team time.
 - Dress comfortably.

Guidelines for a Virtual Workshop

Everyone should behave the same whether the meeting be in person, or virtual where you are in your home workspace. This means conducting yourself as professionally as you would in a face to face environment.

This can be easily achieved by following a few simple rules of etiquette:

- Don't try to multitask. It has been proven through research that people don't multitask, they simply switch from one task to the other rapidly and attention to all tasks suffer as a result. To avoid this temptation, take notes by hand. This has also been proven through research, manual note taking forces you to process the information and actually helps in retention of information.
- What's in the background matters. Keep it professional, no clutter, kids or pets wandering through, and nothing that you could not have in your place based workstation in view of the camera.
- Mute your microphone. If you are not speaking, put yourself on Mute, muting the mic. keeps the conversation clear of noisy distractions. This allows everyone to hear and participate in the conversation.
- Participate Effectively. When you join the meeting, announce yourself (of course during a pause as not to interrupting the current conversation).
 - Speak loudly so you can be heard
 - Snack are allowed, as long as no one can see or hear you snacking.

• Stay in the moment. This means even if you mute your mic and camera, you are actively listening to the conversation. It is especially important during a virtual that Every team member is attentive to the information that is presented since it is impossible to catch up with visual clues or face to face chats.

Appendix C

Value Engineering Job Plan

PHASE	OBJECTIVE	KEY QUESTIONS	TECHNIQUES	TASKS
		What is to be Studied?	Solicit Project Ideas Plan Project	Determine Scope of Study
Dronovation	New and Organiza	Who is best able to Study the	Obtain Authorization and Resources	Select Team Members
reparation	Plan and Organize		Get Information From Best Sources	Gather Project Data
		Study?	Get all Facts & all Available Costs	Create cost models
	Information Investigate Project Analyze Cost	What is the project?	Work with Specifics Challenge Everything	
Information		What is the problem?	Evaluate by Comparison Put \$ on Specs. &	Investigate the Project
		Project What is the cost?	Requirements Put \$ on Key Tolerances &	Analyze Cost
		What is now accomplished?	Finishes Put \$ on Key Standards	
		What must be accomplished?		Speculate on Functions
Function Analysis		What is the basic function worth?		Analyze Functions
	Analyze Function	What are the secondary functions	Identify the Function	Evaluate Function Cost /Worth
		worth?		Evaluate Project Potential
		What are the high cost areas?		Areas

		What is now Accomplished?		
			List Everything -Be	
		What must be Accomplished?	Imaginative	Solact Tochniques to bo
				Select rechniques to be
		Can any Function be Eliminated?	Use Creative Techniques	0360
Creative	Speculate on	Function?	Defer ludament -Do Not	Speculate on Ideas
Cledilve	ldeas		Criticize	
		Where else may the Function be		Speculate on Parameters
		Performed?	Weigh Ideas	
		Llow also many the Function be		
		Performed?		
		How Might Each Alternative	Choose Evaluation	Speculate on Evaluation
		Work?	Criteria Refine Ideas	Criteria
Evaluation Evaluate Ideas	What Might be the Cost?	Put \$ on Each Main	Evaluate Ideas	
		Will Each Alternative Perform the	Alternative	Select the Best Ideas
		Basic Function?	Evaluate by Comparison	
		Work2	Get Information from Best	Speculate on information
			Sources, Specialists &	Speculate on Information
		How Can Disadvantages be	Suppliers	Sources
		Overcome?	Consider Specialty Materials.	Develop a Plan of
Development	Develop	What Will be the Tetal Cest?	Products & Processes	Investigation
Development	Recommendations	what will be the total Cost?	Consider Standards	Develop Selected
	Why is the New Way Better?		Alternates	
		, , ,	Use inew information	Select Preferred
		Will It Meet the Requirements?	Compile all Costs -Work With	Recommendations
		With set sing the subject of sets 2	Specifics	Develop Implementation
		what are the Life Cycle Costs?		

Presentation	Present Recommendations	Who Must be Sold? How Should the Alternative be Presented? What was the Problem? What is the New Way? What are the Benefits? What are the Savings? What is needed to implement the Proposal?	Make Recommendations Use Selling Techniques Be Factual -Be Brief Give Credit Provide an Implementation Plan	Develop a Written Proposal Speculate on Possible Roadblocks to Acceptance Present Recommendations
Implementation	Implement Recommendations	Who is to Implement Change? How Will Plans/Contract be Amended? Have Needed Resources Been Allocated?	Translate Plan Into Action Overcome Problems, Expedite Action Monitor Project	Develop Change Documents Implement Approved Recommendation(s) Evaluate Process

Figure 29 VE Job Plan Steps

Appendix D FAST Diagram Examples Widening Project



Interchange Project



Figure 31 Example FAST Diagram - Interchange

Fish Passage



Appendix E – Agenda Templates for use in Value Engineering Workshops

1 Day Project Element Focused VE

DAY 1				
	Information Phase			
8:00 a.m. – 10:15	Welcome and Introductions			
	Value Engineering Workshop – What to expect			
	Project Team Presentation			
	 Virtual Site visit (using Google Earth) 			
	What are the Constraints and Controlling Decisions?			
	 What are the Operational Considerations? 			
	Review Project Risks			
	Define & Weigh Performance Attributes			
10:15 a.m 10:30 am	BREAK			
Function Analysis Creative Phases				
10:30 am – 11:15 a.m.	Define Project Functions			
11:15 a.m. – 11:45 a.m.	Brainstorm ideas to improve the project and mitigate risks			
11:45 a.m. – 12:30 p.m.	LUNCH			
	Evaluation Phase			
12:30 p.m. – 1:30 p.m.	Evaluate the ideas from the Creative Phase			
	Development Phase			
1:30 p.m. – 3:30 p.m.	Develop best ideas into recommendations			
3:30 p.m. – 3:45 p.m.	Review and practice			
3:45 p.m. – 4:00 p.m.	BREAK			
	Presentation Phase			
4:00 p.m. – 4:30 p.m.	Present VE Findings and Q&A, or submit findings presentation to			
	management.			
4:30 p.m.	Adjourn			

Figure 33 1 day agenda

3 – Day Agenda

DAY 1	
	Information Phase
8:30 am	Welcome and Introductions
8:40 am	Value Engineering Workshop – What to expect
8:50 am	Project Team Presentation
	 Virtual Site visit (using Google Earth)
	What are the Constraints and Controlling Decisions?
	 What are the Operational Considerations?
9:30 am	Review Project Risks
9:45 am	Define & Weigh Performance Attributes
10:00 am	BREAK
	Function Analysis Phase
10:15 am	Define Project Functions
	Creativity Phase
11:00 am	Brainstorm ideas to improve the project and mitigate risks
	Evaluation Phase
12:00 pm	LUNCH
1:00 pm	Continue Brainstorming
1:30 pm	Evaluate the ideas from the Creative Phase
	Development Phase
3:30 pm	Develop best ideas into recommendations
4:00 pm	Adjourn
DAY 2	
8:30 am	Continue Development
12:00 pm	LUNCH
1:00 pm	Continue Development
3:00 pm	VE Team Review of recommendations
3:30 pm	VE Team scoring of VE Strategy
4:00 pm	Adjourn
DAY 3	
	Presentation Phase
8:30 am	Prep for presentation
11:00 am	Present VE Findings
12:00 pm	Adjourn

Figure 34 3 day agenda

3 ¹/₂ – 4 Day Agenda

Information Phase 8:30 am Welcome and Introductions 8:45 am Value Engineering Workshop – What to expect 9:00 am Project Team Presentation In Person or Virtual Site visit (using Google Earth) (Add time for travel and ground time if in person)
8:30 am Welcome and Introductions 8:45 am Value Engineering Workshop – What to expect 9:00 am Project Team Presentation In Person or Virtual Site visit (using Google Earth)
8:45 am Value Engineering Workshop – What to expect 9:00 am Project Team Presentation • In Person or Virtual Site visit (using Google Earth) (Add time for travel and ground time if in person)
9:00 am In Person or Virtual Site visit (using Google Earth) (Add time for travel and ground time if in person)
What are the Constraints and Controlling Decisions?What are the Operational Considerations?
9:45 am Review Project Risks
10:00 am Break
10:30 am Define & Weigh Performance Attributes
Function Analysis Phase
11:00 am Define Project Functions
12:00 pm LUNCH
Creativity Phase
1:00 pm Brainstorm ideas to improve the project and mitigate risks
4:30 pm Adjourn
DAY 2
Evaluation Phase
8:30 am Evaluate the ideas from the Creative Phase
12:00 pm LUNCH
Development Phase
1:00 pm Develop best ideas into recommendations
4:30 pm Adjourn
DAY 3
8:30 am Complete VE Recommendations
12:00 pm LUNCH
1:00 pm VE Team Review of recommendations
3:30 pm VE Team scoring of VE Strategy
4:30 pm Adjourn
DAY 4
Presentation Phase
8:30 am Prep for presentation
11:00 am Present VE Findings
12:00 pm Adjourn

Figure 35 4 day agenda
Typical Prep Session Agenda

Pre-VE Study [Meeting] or [Conference Call] Agenda Project Title

When – Day, Date @ Time PST

1. Confirm dates and meeting location and other logistic information

2. Review VE request and confirm team members.

3. Review VE Study Agenda

- **4. Project Team Presentation -** Who is going to present the project on the first day, and in what format?
 - Project constraints and controlling decisions
 - Project Issues
 - What about this project keeps you up at night?
 - What are the potential risks to delivery of the project?

5. What are the objectives for this study?

- Design (roadway/hydraulics)
- Right of Way
- Utilities
- Management & Funding
- Construction
- Risk Response
- Other?

6. VE Study Information

- We will need the most recent cost estimate sent to us no later than date.
- Please send us a line item estimate in Excel.
- What other design documents are available?
 - Permits Conditions Work windows, restrictions, etc.
 - Accident and Traffic Data (ADT, % Trucks, Peak Hour Volumes, etc.).
 - Various Plans (As-builts, R/W Plans, channelization plans, profiles, and any other plans that are useful)
 - Other project documentation (Geotechnical, Resurfacing, Hydraulic Reports, etc)

7. VE Report-Out is scheduled for date.

- Who is inviting attendees?
- How many are expected?

Example VE Invite to Team Members

Thank you !

For your commitment to participate on the VE Study for the:

PROJECT TITLE

This is an interesting & exciting project that will greatly benefit the local community and the citizens of Washington State. The project team and I am looking forward to the innovative solutions your experience and expertise will bring to this effort during the workshop. This VE study will focus on following functions of the project:

Enter all areas of concern for the study below i.e.

- Environmental
- Design
- Railroad
- Structures
- Contracting & Procurement
- Project Risk.

The objective of this workshop is to create recommendations that assist the project team in developing the best value in overall cost and performance benefits for the project. Your role as a team member is to contribute your knowledge and expertise to identify and develop recommendations supporting this objective.

Project

The Washington Department of Transportation (WSDOT) is conducting a VE Study on the **PROJECT TITLE**

Base Project Description:

Project Description

Workshop Dates

The VE Workshop will be held during the following dates: **VE Study**: Dates of the Study

Location: Location and other Logistics information

Your participation is required for the entire workshop duration unless prior arrangements have been made. We will be working intensively on this project throughout the entire period; therefore, all incoming telephone calls and regular job duty activities should be limited to emergencies. A copy of the VE workshop agenda is attached for your reference, and a link to available project information documents have been included here:

Link to FTP or other data site with materials for team members to review prior to the study

Participant Preparation

Please plan to spend approximately 4 hours prior to the workshop reviewing the documents related to the workshop. Additionally a commitment to attend approximately **#** hours dedicated for this workshop starting **Dates** will be required.

Value Methodology

Along with the agenda is an overview of the VE process, which we will be following for the workshop. This is intended to help familiarize you with the methodology of the VE process. I will lead the team through the VE process during the workshop, explaining each step as we go.

You will need to bring:

- Your knowledge and expertise as a Subject Matter Expert with lessons learned from other projects.
- Reference materials you might need to do design work in your discipline.
- A Laptop Computer One of the major tasks of the workshop is the documentation of VE recommendations during the VE study.

Subject Matter Expert Value Recommendations

As part of each value recommended alternative, each of you will be expected to prepare a comprehensive proposal of the recommendation, these include; a detailed explanation of the concept, sketches, and cost take-offs for your alternatives.

Dress

Dress comfortably. This is a casual, collaborative & creative working environment.

I look forward to working with all of you during this workshop. If you have any questions, please contact me at: Phone Number and Email Address

Appendix F – Other Tools and Templates

T-Chart

A T-Chart is used for listing two separate viewpoints of a topic. Topics can include anything that can be cleanly divided into two opposing views. For example, evaluating the pros and cons of a major decision is a common use of T-Charts. Other opposing views that work well include facts vs. opinions, advantages and disadvantages or strengths and weaknesses.

Project Title				
Advantages	Disadvantages			

Figure 36 T chart template

Paired Comparison

							_	TOTAL	%
Mainline Operations	A								
Local Operations		В							
Maintainability			с						
Construction Impacts		D							
Environmental Impacts			E						
Project Schedule			F						

Figure 37 Paired Comparison Template

Attribute Criteria

Mainline Operations - An assessment of traffic operations and safety on the mainline facility(s), including ramps, and collector-distributor roads. Operational considerations include level of service as well as geometric considerations such as design speed, sight distance, lane widths and shoulder widths.

Local Operations - An assessment of traffic operations and safety on the local roadway infrastructure, including frontage roads. Operational considerations include level of service as well as geometric considerations such as design speed, sight distance, lane widths; bicycle and pedestrian operations and access.

Maintainability - An assessment of the long-term maintainability of the transportation facility(s). Maintenance considerations include the overall durability, longevity and maintainability of pavements, structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.

Construction Impacts - An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to businesses and residents relative to access, visual, noise, vibration, dust and construction traffic; environmental impacts.

Environmental Impacts - An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice, business, residents); impacts to cultural, recreational and historic resources.

Project Schedule - An assessment of the total project delivery from the time as measured from the time of the VE Study to completion of construction.

FAST Diagram Template



Recommendation Development Template

	Recommendation No).	IDEA NO.
Baseline			L
Recommendation			
		-	
Advantages		Disadvantages	
-		•	
	Summary of	Cost Analysis	
		Cost	
Baseline			
Recommendation			
Difference			

Recommendation No.	IDEA NO.
Comments/Justification	

Recommendation No.	IDEA NO.
	1

Recommendation No.	IDEA NO.
Assumptions/Calculations	

Recommendation No.	IDEA NO.

Recommendation No.		IDEA NO.		
Performance Measures				
Attributes and Rating Rationale for Recommendation	Performance	Bas	seline	Recommendation
	Rating			
	Weight			
	Contribution			
	Rating			
	Weight			
	Contribution			
	Rating			
	Weight			
	Contribution			
	Rating			
	Weight			
	Contribution			
	Rating			
	Weight			
	Contribution			
_	Rating			
	Weight			
	Contribution			
Total I	Total Performance:			
Net Change in Performance:		%		

Figure 39 Recommendation Form Template

Appendix G

Glossary of Terms

In 1985, the Lawrence D. Miles Foundation created the College of Fellows of the Society of American Value Engineers (SAVE), now SAVE International, with the specific intent of developing a Glossary of Terms related to value. Over a two year period, approximately 10 Fellows worked individually and in teams to define, refine and finalize a glossary of value related terms.

In 2006, the Glossary was reviewed by the SAVE Certification Board and those definitions most essential to the current application of value methodologies were identified and refined where necessary.

	CVS is the highest level of certification attainable through SAVE International. Designation is reserved for Value Specialists and Value Program Managers who have
	demonstrated expert level experience and knowledge in
	The practice of the value methodology.
COST	The expenditure of resources needed to produce a
CO31.	product, service, or process.
	The sum of all development acquisition, production or
COST, LIFE CYCLE:	construction, operation, maintenance, use, and disposal
	costs for a product or project over a specified period of
	time.
	A financial representation such as a spreadsheet, chart,
	and/or diagram used to illustrate the total cost of families
COST MODEL.	of systems, components, or parts within a total complex
	product, system, structure or facility.
	The original intent or purpose that a product, service or
FUNCTION:	process is expected to perform. It is expressed in a two-
	word active verb/measurable noun structure.

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST):	A graphical representation of the dependent relationships between functions within a project. Classical FAST Model: A function displaying the interrelationship of functions to each other in a "how-why" logic. This was developed by Charles Bytheway. Hierarchy Function Model: A vertical "hierarchical" chart of functions. This places the basic function at the top. The function of each major system is placed beneath the basic function. The functions that support each of these functions are then placed on the next row. This process is continued until the team feels the level of detail is sufficient for the intent of the study. Technical FAST Model: A variation to the Classical FAST that adds "all the time" functions, "one time" functions and "same time" or "caused by" functions. Customer-Oriented FAST Model: This variation of the FAST diagram was developed to better reflect that it is the customer that determines value in the function analysis process. Customer-oriented FAST adds the supporting functions: attract users, satisfy users, assure dependability, and assure convenience. The project functions that support these customer functions are determined by using the how why logic
FUNCTION ANALYSIS:	The process of defining, classifying and evaluating functions.
FUNCTION, BASIC:	The specific purpose(s) for which a product, facility, or service exists and conveys a sense of 'need'. In 'continuous innovation' projects the basic function must always exist, although methods or designs to achieve it may vary. In 'discontinuous innovation' projects, which seek to create new industries, the existence and persistence of the basic function is itself the focus of challenge.
FUNCTION COST:	The expenditure of resources to perform the function.
FUNCTION, HIGHER ORDER:	The specific goals (needs) for which the basic function(s) exists.
FUNCTION, LOWER ORDER (ASSUMED or CAUSATIVE):	The function that is selected to initiate the project and is outside the study scope.
FUNCTION, SECONDARY:	A function that supports the basic function and results from the specific design approach to achieve the basic function.

FUNCTION, SELL:	A function that provides a subjective expression of something that is to be achieved. In Function Analysis, sell functions are qualitative and are described using a passive verb and a non-measurable noun. Sell functions are also sometimes referred to as "aesthetic" functions.
FUNCTION, WORK:	A function that provides an objective expression of something that is to be accomplished. In Function Analysis, work functions are quantitative and are described using an active verb and a measurable noun. Work functions are also sometimes referred to as "use" functions.
FUNCTION WORTH:	The lowest overall cost to perform a function without regard to criteria or codes.
JOB PLAN:	A sequential approach for conducting a value study, consisting of steps or phases used to manage the focus of a team's thinking so that they innovate collectively rather than as uncoordinated individuals. The Job Plan includes 3 stages and 6 phases: Pre-Workshop Preparation Workshop Information Phase Function Analysis Phase Creative Phase Evaluation Phase Development Phase Presentation Phase Post Workshop Implementation
PERFORMANCE:	The capacity of a product to fulfill its intended function. Factors such as reliability, maintainability, quality and appearance are some examples.
PROJECT:	A temporary endeavor undertaken to create a unique product, service, or result. For the purpose of Value Studies, a project is the subject of the study. It may be a physical product such as a manufactured item, or a structure, system, procedure, or an organization.
PROCESS:	A sequence of activities that delivers a product or project.
SAVE INTERNATIONAL® CERTIFIED PROFESSIONAL:	For the purpose of a Value Study, the Job Plan shall be facilitated by a Certified Value Specialist® (CVS). SAVE International® Certification requirements are identified by the SAVE International® Certification Board, which maintains a list of currently certified individuals.

SCOPE:	The portion of the overall project that is selected for the value study. The analysis accepts everything within the defined scope in order to focus attention on the functions within those limits.
VALUE:	An expression of the relationship between function and resources where function is measured by the performance requirements of the customer and resources are measured in materials, labor, price, time, etc. required to accomplish that function.
VALUE ANALYSIS:	The application of value methodology to an existing project, product or service to achieve value improvement.
VALUE ANALYST:	See VALUE PROFESSIONAL.
VALUE ENGINEER:	See VALUE PROFESSIONAL.
VALUE ENGINEERING:	The application of a value methodology to a planned or conceptual project or service to achieve value improvement.
VALUE INDEX:	A ratio that expresses function cost ÷ function worth. This ratio is used to determine the opportunity for value improvement, which is usually identified in the Function Analysis Phase.
VALUE MANAGEMENT:	The application of value methodology by an organization to achieve strategic value improvement.
VALUE METHODOLOGY:	A systematic process used by a multidisciplinary team to improve the value of projects through the analysis of functions. See Value Engineering, Value Analysis and Value Management.
VALUE METHODOLOGY ASSOCIATE (VMA)	VMA is a recognition designed for individuals who are new to the value methodology. A VMA is encouraged to progress to CVS certification.
VALUE METHODOLOGY RECOMMENDATION (or PROPOSAL):	A recommendation(s) prepared by the value study team and presented to management to provide financial and/or performance improvements and which is within acceptable terms and conditions of the Value Study.
VALUE PROFESSIONAL:	One who applies the value methodology principles to study and search for value improvement. Synonymous with value analyst, value engineer, value practitioner, or value specialist.
VALUE PRACTIONER:	See VALUE PROFESSIONAL.
VALUE STUDY:	The application of a value methodology by SAVE International® certified professionals using the Value Job Plan.

Figure 40 Glossary of Terms