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COST ENGINEERING

A Series of Reference Books and Textbooks

Editor

KENNETH K. HUMPHREYS, Ph.D.

Consulting Engineer
Granite Falls, North Carolina

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30. Value Engineering: Analysis and Methodology, *Del L. Younker*

Additional Volumes in Preparation

Preface

In today's economy, businesses, whether public or private, are striving to improve the value of products, projects, programs, processes, systems, and techniques. These efforts can be improved with a well-known, but often unused method called the value methodology.

As this material is not new in some areas, it is *how* the methodology is used that can make strides in improving value. While use of the value methodology can reduce the costs, it can do so much more by improving teamwork, adding value, and developing the right project, process, program, project, system, or technique.

A specific area of interest, in addition to learning and practicing the job plan, is the identification of value mismatches between what an item costs and what it is worth. The building of teams through function analysis and practicing good people skills can strengthen the team's use of the job plan to create, select, develop, and present to management solid alternative ways to improve the original concepts. The book emphasizes certain areas that can be focused on during a value improvement study effort.

Value Engineering covers aspects of value improvement studies that can be used as a learning course or as a teaching reference. The life cycle cost and team leader practice situation problems and exams are to be used as a review of the material and provide tools to help learn the material being covered.

Chapters 1–25 provide an introduction to the value methodology. During this course of instruction an actual project may be concurrently used with the reading material to conduct a value improvement study on a project, program, process, system, or technique so that the group may demonstrate to management the benefits of using this improvement tool. Chapters 26–55 focus on practicing as team leaders to guide the group through example problems provided.

As this field continues to grow, more and more professionals may be needed to improve value. We are responsible for finding and using methods such as the value methodology to improve the outcome of each item being planned. As the Association of General Contractors stated a few years ago, we can change our

future one project at at time, and so can we improve our future one project at a time by practicing the value methodology, well known and used by some, and unknown to others.

Value Engineering is intended for interested professionals who want to learn "how to" apply this methodology to improve value and their future plans. It can also be used by others who want to study how to use the step-by-step value methodology approach to improving projects, products, processes, programs, systems, or techniques as a team member or team leader.

I thank my family and others who have put their hearts into making such great comments, suggestions, and edits. I dedicate this to my brother who did not have a chance to get to see this effort through.

Del L. Younker

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1

Managing Value Objectives Using the Value Methodology

The purpose of this information is to provide a comprehensive value methodology (VM) publication for the training and guidance of team members and team leaders participating in value improvement studies. One of the most critical factors governing the success of a value engineering (VE) team is the effectiveness of the team leader and members. These ventures must also encourage the enthusiasm and interest of team members but at the same time adhere to a proven, formalized, process for conducting value improvement studies. The team environment permits free discussion by members. Establishing and maintaining the momentum and pace of a team effort is an important function of the team leader in directing the individual phases of a study, which includes assignment of team member tasks.

This information, along with the examples used during the training or use of reading the material, will allow the user/team to receive the tools and techniques to conduct workshops/studies on a variety of projects, programs, processes, and products. Included with this manual are training slides and exam questions.

The VM is one of prime importance to improving value. Value improvement may be accomplished by many means and is done so throughout our economy. The methodology covered within this book is well known and practiced by the value practitioners, but this book is written for those not practicing the value methodology. Tips and techniques are discussed and examples are shown for future reference and practice by those interested.

ESTABLISHED BY SAVE INTERNATIONAL

As is common knowledge among the value practice tribe, Lawrence D. Miles began the practice now known as the value methodology. The Society of American Value Engineers (now called SAVE International [SAVEI]) was initiated as an organization dedicated to strengthening the value methodology practice. The SAVE organization has membership spread throughout the world. The United States membership has been growing, but can hardly keep up with the demand needed for teaching, certifying and providing the talent of value practitioners to fill the industry requirements. The demand has evolved from those that use the value methodology. In recent years the value methodology has been mandated by the United States federal government (reference Public Law 104-106) for use on program budgets over $1 million.

President Clinton signed Public Law 104-106 on February 10, 1996, as the Defense Authorization Act, which contains a special section of procurement reform for the entire executive branch, not just defense. It says that each executive agency shall establish and maintain cost-effective value engineering procedures and processes. VE means an analysis of the functions of a program, project, system, product, item of equipment, building, facility, service, or supply of an executive agency performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety, and life cycle costs. The United States government has established incentives for branches of the government establishing VE programs that use the value methodology on budgets over $1 million.

The General Accounting Office estimated that value engineering efforts saves the U.S. government between 3–5% of each program costs. According to the Hoving Group, savings reported by agencies in a recent year include by agency: Defense Department = $734 million, Department of Transportation = $687 million, General Services Administration = $110 million, Army Corps of Engineers = $60 million, Department of the Interior = $23 million, Department of Agriculture = $9 million, Justice Department = $6 million, Veterans Affairs = $3 million, Health Services = $2 million, International Development = $1 million, and the State Department = $1 million. Please refer to the Hoving Group's latest publications for updated figures as they change from year to year.

As a result many public and private agencies/companies use the methodology as a method to improve value. SAVE has published its own Value Methodology as a standard approach to value improvement. ASTM has also published its recommended Value Analysis procedure (E1699), written mostly for buildings but is applicable to any item.

IMPROVING VALUE WITHOUT SACRIFICING FUNCTIONS

The main reason the value methodology is different than any other cost reduction process is the focus on functions. What is a function? A function is usually ex-

pressed best by using a verb and a noun. An example would be—what is the function of a light bulb? Expressed by a verb and a noun—the function is illuminate space or surface. There of course may be other functions, but illuminate surface may be considered the most basic function for the light bulb.

We cannot ignore the fact that every thing has function. Therefore a function(s) is the backbone of the development of the task. So when embarking on a venture to improve the task we need to break down the task into individual functions. Why focus on functions? Mainly, to improve the current ability of the task or item to perform as expected or wanted. Whenever functions are described in a value methodology study it becomes evident where the team should focus their effort to make possible improvements. So when we focus on functions we are certain we will not sacrifice wanted or needed functions. However, if we focused on items of work, costs, time, attitudes, features, or other items we may not even get near the real potential of value improvement.

AN ORGANIZATION WITH INTERNATIONAL TIES

SAVEI is a diverse organization with value practitioners throughout world. International SAVE members include Afghanistan, Australia, Brazil, Canada, Egypt, England, Finland, Germany, Hong Kong, Hungary, India, Indonesia, Italy, Japan, Korea, New Zealand, Peoples Republic of China, Portugal, Qatar, Russia, Saudi Arabia, Singapore, Slovak Republic, South Africa, Singapore, Spain, Taiwan, Turkey, United Arab Emirates, United Kingdom, and Venezuela. More members from other countries are soon to be added. Some countries have their value society similar to SAVEI in the U.S.

This sharing of practitioner knowledge greatly improves the methodology. The VM consists of usually several steps or phases that when taken in proper sequence reaches a conclusion or recommendation that holds much promise to improving the item under study by the professionals selected for a particular study. It is important to have knowledge of the national and international practitioners in various fields as their expertise may be needed in certain areas on occasion, depending on the subject and complexity of the project, product, program, or process.

VALUE ENGINEERING HISTORY

The name value engineering is a common name used for the VM. It was established by the Society of American Value Engineers (now SAVEI). The value methodology originally began with Lawrence D. Miles when he practiced the methodology with General Electric (GE). Mr. Miles was forced to continue to find ways to produce products for GE using fewer available materials that was being consumed for World War II purposes. United States Bureau of Ships decided to use the value analysis process practiced by Mr. Miles, but the only way

they could add new employees to do the value improvement work was to call them engineers not analysts as Miles suggested. Thereafter, the trade was earmarked with a name of value engineering. VE was known to improve value without sacrificing intended functions on purpose.

Through the use of the VM trained value improvement team leaders conduct thousands of studies per year to produce an annual savings of over $1 to $3 billion for the United States. The methodology does more than reduce costs but has other benefits to improve time, performance, quality, as well as determine the type of work that should be performed. At this time there are currently not enough practitioners in the field and the United States is joining an effort to expand the knowledge and practice to others interested in improving value for their programs, projects, processes, systems and techniques. The SAVEI has current information on the number of Certified Value Specialists. Some nations may have more professionals certified in this field according to their standards that may vary slightly from the certification standards set by the SAVEI in the United States. So there is no question that more professionals are going to be needed to meet the demand of value improvement in the future.

Just to mention a few more frequent U.S. government continual users of the VM are the Environmental Protection Agency, Department of Transportation, Federal Highway Administration, Federal Transit Administration, Department of Energy, Department of Defense, Bureau of Prisons, Corps of Engineers, Navy Facilities Engineering Command, City and County Governments. Some of the potential users of VM that are, or may be, developing programs are banks, privatized developments, insurance companies, legal counseling, manufacturing suppliers, foreign investment developers, design/construction contractors, and public/private education facilities owners. All of the users of VM want to manage value objectives by conducting organized, systematic, and deliberate efforts to analyze functions versus things or products. They all have a common goal to achieve basic, necessary, essential functions at the lowest overall life cycle cost. They believe that essential characteristics should be achieved without sacrificing performance or quality.

The Association of General Contractors says we can change our future one project at a time. This is what managing our value objectives (MVO) can do, improve our future one project at a time. It seems like a difficult task to review the item in detail to make improvements but by using the MVO we can improve the overall future one item at a time. Together we can build a better future sooner, better and more economically than we could have imagined without doing MVO. Mr. Miles got better results by focusing on functions not just parts of a mechanism; we can apply the same thought process to our everyday lives regardless of what the challenge may be.

Usually best results are achieved when multidiscipline teams are formed to study the task. This approach solves problems using a job plan lead by a CVS facilitator. So why isn't this methodology used more often, it meets stiff resistance due to recommendations resulting in changing the normal way we have been

doing or planning the tasks. Significant savings (tangible and intangible) can be achieved with minimal efforts, which find and recommend better solutions. Solutions that can be tailored fit to the needed functions and provide for more easily constructible and operable/maintainable projects.

By reference to a former *Value World* editor-in-chief Jack V. Michaels, Ph.D., CVS the following milestones are evident from the time Mr. Miles developed a step-by- step methodology and formal workshops were held to improve products.

SIGNIFICANT VALUE ENGINEERING MILESTONES (AS NOTED BY THE AUTHOR)

World War II:
At General Electric, substitutions for critical materials dictated by shortages resulted in products that accomplished their function at reduced cost.

1947:
Mr. Lawrence D. Miles, General Electric Staff Engineer, was assigned to the purchasing division to study a new proprietary concept where he succeeded in developing an amazing new package of techniques he named value analysis" (VA), to make the cost saving coincident of WW II occur purposefully.

1952:
Mr. Miles conducted the first VA workshop seminar.

1954:
U.S. Navy Bureau of Ships applied VA to cost avoidance during design, calling it Value Engineering. First government organization to use this new technique.

1956:
Watervliet Arsenal, under the former U.S. Army Ordinance Corps initiated a VE program. Results proved so rewarding within the first year that the program was rapidly expanded.

1958:
Lawrence D. Miles was awarded the U.S. Navy's highest civilian honor, the Navy Distinguished Public Service Award for his assistance to the Bureau of Ships in VE.

1959:
Society of American Value Engineers (SAVE) was founded in Washington, D.C. to unite all practitioners and promote the growth of the profession.

1960s:
Mr. Charles Bytheway, developed a tool used during VE analysis called the function analysis technique (FAST) diagramming which can identify, classify, and denote functions that should be focused on by the team. This diagramming technique is useful for building teamwork and getting consensus from the team on the problem and identification of potential areas for improvement.

1961:
Value engineering contract clauses established in Armed Forces Procurement Regulations permitting contractor sharing in VE cost reductions.

1962:
In December, the Department of Defense announced that it was making VE a prerequisite for all D.O.D. contracts over $100,000.

1963:
U.S. Navy Bureau of Yards and Docks began applying VE to their construction program, being the first military construction agency to write a VE incentive clause into an awarded contract. Two other military branches followed their lead.

1964:
U.S. Army Corps of Engineers VE program started.

1965:
A Japanese delegation visits SAVE for assistance with problems, marking the start of Japan VE programs.

1966:
U.S. Bureau of Reclamation began placing a VE incentive clause in their construction contracts.

1967:
Post Office Department (now the U.S. Postal Service) instituted a formal VE program by creating a full-time VE staff.

1969:
U.S. National Aeronautics and Space Administration, Office of Facilities, began conducting formal VE studies and training.

1970:
U.S. Congress endorses VE by recommending its use of Federal-Aid highway projects.

1970:
General Services Administration (GSA) began its building-contractor VE program and started use of incentive clauses.

1971:
U.S. Department of Health, Education, and Welfare (HEW) adopted the use of VE on its construction project.

1972:
The Veterans Administration joined the VE group.

1973:
SAVE establishes a program for certification of value specialists.

1974:
In April, the use of certified value specialists for value work in GSA construction became a requirement. FHWA established an office to administer the VE program on federal aid projects.

1975:
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."

1976:
Florida Department of Transportation established a VE Program, realizing the benefits from VE. Other states established programs and can be found by contacting individual state VE coordinators listed in the American Association for State and Highway Transportation Officials (AASHTO) value web page.

1977:
The Lawrence D. Miles Foundation is incorporated.

1980:
Miles is awarded the Presidential Citation by the Society of Japanese Value Engineers.

1982:
The Department of Defense establishes its honorary VE award programs.

1985:
L. D. Miles, the father of value engineering died on August 1.

1987:
The governor of Minnesota declares the week of May 23 Value Engineering Week. The AASHTO published the "Guidelines for VE."

1988:
The governor of Indiana declares the week of June 11 Value Engineering Week.

1993:
The Office of Management and Budget issued a circular calling for government wide use of Value Engineering.

1996:
Public law 104-106 requires each government executive agency to establish and maintain cost-effective VE procedures and processes. (Ref. Value World issue October 1997.)

1997:
FHWA expanded the rule by publishing the 23 CFR Part 627 requiring VE analysis on all federal aid highway projects on the national highway system with an estimated cost of more than $25 million.

RECENT VE HISTORY

The SAVEI society is working with all agencies nationally and internationally to further the understanding, knowledge, training, and facilitation of value improvements techniques worldwide. SAVEI is formulating plans to offer corporate sponsorships to interested corporate partners worldwide to assist both SAVEI and the individual companies expand the knowledge and help shape the future of this value improvement process.

AVAILABLE INFORMATION FROM SAVEI

SAVEI is an organization that holds a wealth of information that can help the future practitioners. Information may be obtained by joining the organization and a local chapter, attending annual conferences, attending regional training seminars, accessing the Miles Value Foundation library, and learning from the many value practitioners/consultants. The SAVEI website has information on the methodol-

ogy, the steps to certification and current up to date information on their involvement to expand membership.

Publications are available through their publications catalog. VE and function analysis courses are taught at some universities. Contact SAVEI headquarters for more information or visit their website address (www.value-eng.org).

2

Discovering the Certification Process

SAVEI's certification program offers three categories of certification:

- Certified Value Specialist (CVS)
- Associate Value Specialist (AVS)
- Value Methodology (Management) Practitioner (VMP)

CVS is the highest level of certification attainable through SAVE International. Designation is reserved for value specialists or value program managers whose principle practice has been utilizing the VM for at least two years (varies depending on experience level) full time, and has met the education plus experience requirements, and passed the CVS examination.

AVS is a milestone recognition designed for individuals who are new to the VM. This certification is recognized for four years (or longer depending on certification requirements currently under consideration to extend this certification) and is not renewable currently (but according to certification considerations underway this certification while may not be renewed may be good for an extended period of time). Points accumulated by an AVS can be applied towards either a VMP or a CVS.

VMP recognizes individuals whose principal occupation is not in the VM field, but use VM techniques as part of their profession. A VMP must complete the education and experience requirements for this level of certification and pass the VMP examination. When the VMP becomes a full time value specialist, they are encouraged to apply for CVS status. All points accumulated as a VMP may be applied toward CVS certification.

STEPS TO CERTIFICATION

The certification program is composed of two major elements: individual professional certification and educational program approval.

The highest level is the CVS, which is recognition of the individual who has met all certification requirements, both technical and experiential, and whose principal career is value engineering.

The AVS program recognizes those individuals who decided to become professional value engineers but who have not yet acquired all the experience or technical skills expected of a CVS.

The VMP program was established to recognize those individuals who acquired the basic skills of value engineering/analysis but their principal career is not value engineering.

The CVS and VMP must recertify periodically. After AVS certifications are awarded for it is recommended the AVS continue to achieve the CVS or VMP certifications. Membership in SAVE is not a requirement for individual certification or for educational program approval, but it can be beneficial to stay abreast of the activities in the field.

WHO ADMINISTERS THE PROGRAM?

The certification program is administered by CVS's appointed by the SAVEI board of directors for multiyear terms. All attempts are made to have the board represent a cross section of the society and applications, including industry, government and construction and members from both internal programs and consultants.

It must be emphasized that the certification program is designed for those utilizing the value disciplines in their principal career. It is not an honors program. The society has a separate program to honor deserving individuals and organizations. Certification must be earned by completing all criteria and requirements and is for individual recognition and may not be transferred or used to imply that an organization or association is certified.

The SAVEI certification board also maintains a cooperative certification program with the Japanese Society of Value Engineering, the Society of Korean Value Engineering, the Indian Value Engineering Society and the Society of Hungarian Value Analysts whereby they meet all SAVE requirements as a minimum but also adapt the overall requirements for their own culture. Talks are being conducted with other regions to establish similar programs.

WHERE DO I LEARN VALUE MANAGEMENT?

The best and most convenient way to learn the techniques of value management, their application and their management, is as a member of SAVEI.

Your SAVEI membership gives you opportunities for career growth, professional development, information, contacts, new ideas, involvement and recognition. All this lays the foundation for your greater career success!

The certification board currently issues certification, recertification, and seminar/workshop manuals that describe these programs and requirements in detail which include application forms. The board also issues a study guide to assist applicants in preparing for the examinations.

The certification administrator maintains a master record of the current status of all CVS's and courses. If you have additional questions, or wish more information about certifications, status of CVS's or courses, or copies of the manuals or guides please contact the certification board administrator.

3

Cost Overrun Trends

All too often a project, product, process, system, or technique tends to have scope creep. Before long the rebaselined scope budget exceeds the allowed or intended budget. These types are excellent candidates for a VM study. Other factors can contribute to cost overruns besides scope. Some examples of cost overruns stem from escalation, change in objectives to be accomplished, market demand, labor shortages, material shortages, cost of development of the property, weather conditions, specification changes, rule or federal mandates/changes, agency treatment requirements, environmental regulations, changes from previous or future contracts, and management decisions.

USE OF THE VM

Cost overruns may be reduced by the use of the VM. Reviewing the cost overrun item takes time, commitment, dedication, and the team's ability to overcome roadblocks.

To determine if a cost overrun item is a good candidate for value study the following may be used as a checklist for selection criteria. Federally funded projects usually require value improvement studies. The project design team or client team may want the study performed to determine if the design could be improved before it is finalized. The location of the project may warrant a value improvement due to certain conditions that may exist on the site or nearby sites. The type of project underway may be a candidate because of the nature of the interfacing, complicated, time consuming tasks that must take place and therefore may not be cost efficient. If it is not a well-developed field yet this may prove to be good a candidate for improvement. The facility size or amount of steps involved may be

so great that it warrants a review from a value improvement team. Parametric cost data may indicate that the cost per function is not in line with similar projects. The design, manufacture, or construction has not evolved very far and has time to implement recommended improvements. The functions do not seem to fit very well in the manner shown by function analysis. Even if the item has been through the value improvement study before does not mean there is not room for further improvement (maybe in other areas). That there appears not to be enough time to gather a group to study the potential item is not a reason to preclude it from value improvement recommendations. The item is within budget therefore one may not subject it to a value improvement study, but in fact may be the reason to study the project to find further improvement, and reallocate remaining budget to another area for more improvement methods. Some potential study items are spilling over with potential for improvement. The owner may desire to make improvements and suggests the study take place. After further analysis the schedule durations may appear to be potential area for improvement. Last but not least, the cost overrun item may have issues/team attitudes that need resolution through the MVO process.

Keep in mind that each agency may have their own variable method rather than the one identified as the VM to use as discussed in this material. In fact, the writer uses variables methods from those shown here to provide for best management methods to meet the value objectives.

Certain agencies, corporations, and companies have developed lists of items that have potential for value improvement. The cost overrun trend factor is just one variable that can be identified for a potential for value improvement. Other factors that may need improvement are related to time, level of effort, location, changing conditions, performance, upstream or downstream previous improvements or anticipated improvements that impact this current item or process.

4

Meeting Project Value Objectives

GETTING THE MOST FOR THE BUDGET

As good stewards of the project budget our managers are trying to get the most out of every dollar budgeted. It is good to know that there are several tools available to the budget manager to control the budget expenditures and allocations to start and complete the item(s) being budgeted.

First of all the manager assembles the team to work according to the budget. The product must be a well-coordinated budget approach so we assign a project coordinator. The team prepares a plan and works according to the plan. The team budget may include cost and time to perform the value management activities needed to improve the item as built in work plans or as milestone events.

The team has many challenges during their time together on the item. The item must have team members that have a common goal, strong leadership, and plans that are tailored to the conditions. The team plan includes rational steps to achieve the intended functions, while meeting the applicable codes/regulations. Teamwork on the item is not in a vacuum; participation from all parties must take place and be a coordinated effort.

The team goes about their plan much the same way the MVO study is accomplished. One of the first steps is for the team to gather information. Constraints must be identified and a plan to work within each constraint agreed upon. The budget for the item must be developed often as a top down approach before the team has had a chance to view the options and develop a more rational detailed budget. In addition, the item should include a life cycle budget so that the MVO team can make comparisons or as options are refined as the product evolves. The

team, in its everyday efforts, usually develops its own improvement techniques, which are documented and agreed upon by the owner.

An important aspect of budget management is time management. The team should have clear objectives and work within the time constraints to achieve the budget expectations. The more time it takes the less efficient or more costly the item will be and the budget item exceeded.

Up front one of the first items the team leader should grasp is the client or owner objective. The team plan should be formulated to meet the objective, and if not, agree among the parties on how these objectives are to be reached. An important aspect of the team meeting the objectives is to get their buy-in when the budget is developed.

Initially, many pre-selected management teams automatically have a built in sub-team to review the value objectives and set goals for them all to meet to start and complete the item with certain expectations. Teams have many objectives, such as focusing on value while focusing on improving quality and performance. In order to get the most value out of a value team study, contributions are made by all disciplines. The team member disciplines are derived from choosing disciplines representing the major cost portions of the item under study. The team cost budget may or may not be itemized by function before the study, but this itemization would help the team leader determine which disciplines are needed.

It is our job to produce the most economical item according to size, appearance, weight, time schedule, tolerances, vibration specifications, temperature, and others as applicable for a value improvement item under study. Some of the most difficult jobs are analyst's/engineer's functions. They are asked to search for and develop an item based on one's own experience and expectations. The engineer not only designs the item, but must also be adept at calculating accurate cost estimates for the items. One must also keep up with the state of the art materials and techniques available. Methods of procurement, delivery, installation, and manufacturing are also key to deriving a competitive product. Maybe the most sought after attribute of the selected engineer for the item is the ability to meet the desires and needs of the client value objectives and functions necessary to provide the program on a tight balance of performance, time and cost. Of course an expectation is that once all the ingredients are ready the engineer must make the right decision that leads to the most economical design when all the ingredient mix is finished.

Another difficult position is the purchasing agent must add value to the end product. The purchasing department often has reason to suspect that good value is not being obtained on particular items in the product line. The project analyst (PA) has valuable data about the specialty vendor knowledge and what the vendor can contribute to the value objectives. The PA is keenly aware of the climate among the industry as they communicate with the suppliers on a daily basis and attend trade shows where information is exchanged between the cast of interested parties. The PA is able to identify, almost at the fingertips, the material that can be

obtained at a more economical cost that performs the same or may have performed more functions (at no additional cost) than may be currently desired.

The marketing job is the front line of the value crew. They have years of experience and are aware of works in this situation. They are aware that lower costs do not always mean lower prices. They are the ones skilled at identifying the customer's needs. Often together with the customer, alternatives are devised. For special projects they are talented at adapting to meet the needs to satisfy functions at the most economical overall cost. While they may be securing orders, they at the same time must be responding to the previous problems and solving solutions with feasible costs. Often these marketing experts are worth their weight in gold on the MVO study.

The proof is in the pudding when the manager makes the proper decisions to prove the venture is a profitable one. The manager skillfully uses the resources of capital, labor, materials, equipment, and time to build. Since cost and value is everyone's business, it is no single individual's business. The manager is the one that strives to provide the organization with the tools to make the business successful, and MVO is a tool to provide management with successful ventures.

REDUCING LIFE CYCLE COSTS

If anything is of benefit to the product, it is that overall life cycle costs are improved. What are the life cycle costs of one option versus another option? Why would one option be chosen over another even though it costs more over the life cycle? Sometimes the initial additional investment (or savings) outweighs the overall life cycle savings even when viewed from a present worth perspective.

IMPROVING PROJECT UNDERSTANDING

Project understanding is greatly improved when the team is dynamically focused for a short period of time on the item at hand. Not everyone understands the item the same way. Through a conscious effort of bringing all the disciplines together on one study for a specific purpose, they gain insight to the whole situation where before only a glimpse may have been known. By knowing the objectives from everyone's vantage point they themselves will perform better at their duties. The group working together over a short period can solve solutions to overall problems much faster, rather than spending time separately and only gaining advice periodically.

CREATING BETTER WORKING RELATIONSHIPS

Better working relationships create better products. Better working relationships create bigger opportunities. Better working relationships add value. Better working relationships can add profit and reduce waste. Relationships that are in harmony cause more repeat work to occur. It is feelings and relationships that make

the world go round. The MVO study for the item under study creates an opportunity to start from scratch and review the whole process that led up to this point in time. An excellent opportunity exists that we should not waste, because it can work to our advantage and goal of improving the product, program, project, system or technique.

Before we choose the project and team and location, we first must set some objectives:

- Obtain the most value for the budgeted program cost
- Emphasize that team work is necessary to accomplish the effort
- Tailor our work process to the need of the project
- Follow rational steps to achieve the intended functions
- Continue to meet state, local, and federal/agency codes
- Obtain full participation from the VE team as well as others to achieve the greatest results

In order to meet the objectives of the project goals first the team leader needs to:

- Gather information
- Identify the constraints
- Confirm the life cycle cost estimate for the current facility
- Identify potential construction improvements
- Manage the time
- Find ways to meet the client objectives within the timeframe
- Obtain buy-in and resolution on accepted alternatives
- Follow through from the beginning to the end

WHAT IS THE VE TEAM'S OBJECTIVE DURING THE STUDY?

- Should the study be concerned with the present quality or performance presently in place
- VE is a team effort, requiring contributions from all disciplines
- Apportion costs to appropriate areas so the team can focus
- Determine the costs per function, this not usually accounted for during design/estimating

It is our goal to utilize the forces of nature and materials of the earth in the most economical way to better our future and to design the most economical project. Interference's that may occur related to size, appearance, weight, time schedule, tolerances, vibration, temperature, etc; need to be pre-planned and considered.

WHO HAS THE MOST DIFFICULT JOB?

- Engineer
- Purchasing agent
- Special projects
- Organizational manager
- Other position

All of these professionals have a common interest, even if we debated which has the most difficult job. Their common interest is to improve the product, project, process, service, or technique so that the entity can be more successful.

WHAT TAKES PLACE DURING AN ECONOMICAL ANALYSIS?

- Life cycle costing is VE, or not?
- Should we design to the budget? Or should we budget what is designed?
- What is a performance specification?
- Do we know what is involved with a systems analysis?
- What does a trade off analysis mean?

If we could, would we want to standardize certain components of the design, manufacturing, construction, spare parts replacements, everyday or cyclical maintenance? Sometimes during a value study we often hear team members ask questions related to: are quality measurements being improved, or is the quality we intended in the beginning being achieved? Safety is a factor in all designs, but we design a safe project for every project?

There may be ways to simplify the work process. Review the work as you would if you are the contractor or responsible person making the product, process, system or technique work, how would the item look, fit, be maintained, be driven, be observed by others, or act in certain conditions.

Look for way to avoid defects or errors from occurring, during VE we want to uncover potential noted problems before they occur. VE can look at ways to reduce costs and still accomplish the same functions. We would rather review the project before we are handed the project (sometimes expected to reduce costs, but the project also loses the intended function).

5

Users of Managing Value Objectives

POTENTIAL USERS

As mentioned earlier, the current largest known users of the VM are government agencies. There are others using the VM that reach across many industries including private companies such as Lockheed Martin, General Motors, and Marriott Corporation just to name a few. Those that are not using VM are losing out on providing better services to the customer. The customer is the one who determines the value of a product, project, program, or process.

The VM has become a natural methodology for many, but some have not even heard or learned about how the methodology can improve their business.

Use of the VM gets results. As shown earlier, the federal government may see improvements ranging over $1 billion on a yearly basis. The trillion dollar economy could take advantage of this secret improvement method to provide for customer satisfaction at a reduced cost yet fulfilling the necessary functions. If one can imagine a ten percent improvement in a trillion dollar economy everyone could see how the improvements would feed on one another.

These savings should not be viewed as cost reductions but as allowances to provide for more product lines, or focused attention in other areas for improvements thus adding value and profit to the industry and nation.

Results of value improvements for the federal highway administration are shown in Table 1.

6

Value Objectives Methodology

WHAT IS VALUE ENGINEERING?

Definitions

Value engineering (VE) is an organized effort directed at analyzing the function of goods and services for the purposes of achieving basic functions at the lowest overall cost, consistent with achieving essential characteristics.

VE is a process using multidisciplined teams to review projects and standards to identify high cost functions with improvement potential. The teams follow the systematic, creative VE job plan to establish an optimum value for selected functions. Alternatives, which will provide the necessary functions at the most economical initial capital costs and/or life cycle cost, are developed consistent with requirements for safety, quality, operation, maintenance, and aesthetics.

VE Concepts

Why Use VE?

By using VE we have a powerful proven methodology to:

- Solve problems
- Reduce costs
- Improve quality
- Improve performance

- Maintain intended functions

Return on investment has ranged from 10 to 1 to 1,000 to 1. VE (synonymous with VA or VM) is a function-oriented systematic team approach to provide more value for a program, process, product, service, system, or technique.

VE Philosophy

Often, this improvement philosophy is focused on cost reduction; however, other improvements such as customer-perceived quality and performance are also paramount in the value equation. VE techniques can be applied to any product, system, or service in any kind of business or economic sector, including industry, government, construction, and service. VE focuses on those value characteristics deemed most important by the customer.

Need for VE

Cost analysis for our projects is a part-time job. Since this is so, we have many products, services, and systems that have built-in unnecessary costs. Even though the design has nearly reached completion the use of VE can provide benefits not previously achieved. VE has side benefits to reducing overall life-cycle costs and it can find ways to utilize our resource (people, time, money, and materials) better. VE happens on purpose, so we can create the change that is necessary before it is too late. VE also provides many professionals with a new avenue of improving projects by managing value objectives (MVO). On each case the team has value objectives they would like to meet. So the team will strive to manage the future course of action in order to meet those value objectives by using VE.

VE Helps Your Organization:

- Increase bottom-line profits
- Solve problems
- Use resources more effectively
- Improve costs
- Save time
- Increase market share
- Compete more successfully in national/international markets
- Improve resource efficiency
- Improve quality
- Reduce risk
- Manage value objectives
- Resolve issues
- Increase potential for improved return on investments

- Recover schedule delays

VE Helps You:

- Expand your career skills
- Improve your status and visibility within your organization
- Provide additional justification for advancement in your career objectives
- Take command of a problem-solving methodology to use in any situation

How Can VE Be Applied?

The VE technique is governed by a structured job plan to assess the value of products, projects, programs, processes, systems, services, and techniques. A VE job plan can be implemented when unsatisfactory value is suspected. The plan involves the following phases:

General: Before actual work begins, a foundation should exist consisting of good human relations, teamwork, and management support so that an effective interaction can take place and work can focus on specifics.

Information: Secure facts, determine costs, and fix costs on specifications and requirements.

Function: Define the function, evaluate function relationships (FAST diagramming), and identify costs for these functions. When possible, customer attitudes concerning functions are included.

Creativity: Establish positive thinking and develop creative ideas in a team setting.

Evaluation: Refine and combine ideas, establish costs on all ideas, develop function alternatives, and evaluate by comparison.

Development/Recommendation: Develop and present proposals that resolve the study issues and motivate to action.

Implementation: This is the phase of the job plan in which the proposal is implemented and the product is improved by acceptance of VE recommendations.

There are two keys to the VE discipline: (1) The phases must be taken in the proper sequence as outlined above and (2) the unique method of function analysis must be used, and when appropriate, customers' perceptions of worth to the functions must be related. When cost reduction is the objective, this discipline can achieve impressive savings far above the norms of traditional cost reduction techniques.

VE Benefits

Where Do I Learn VE?

The best and most convenient way to learn the techniques of VE and its application, is as a member of the Value Society (SAVEI). SAVEI is a professional society dedicated to the advancement of VE through education, which provides a better understanding of the principles, methods, and concepts of value technology. SAVEI has members in virtually every state in the union, as well as in more than 35 other countries around the world. SAVEI also maintains a network of regional chapters throughout the U.S. to give members additional networking and educational opportunities at a local level.

As a SAVEI member, you can learn VE through these member activities and services:

- Chapter meetings and programs
- Chapter-sponsored regional seminars
- SAVEI publications and videotapes
- Value World journal articles
- SAVEI annual conference and proceedings
- Professional development through certification
- Standards of practice
- International contacts
- Special technical seminars
- Influencing legislation

Your SAVEI membership gives you opportunities for career growth, professional development, information and resources, networking and contacts, new ideas, involvement, and recognition. All of this provides the foundation for greater financial success.

In order to know more about value analysis, a few important definitions are included in the SAVEI certification study materials, and other government agency value improvement guidelines.

Additional terms discussed during value studies may be found on SAVEI's website

The Job Plan

The structured job plan technique is very helpful in providing for assessment and evaluation of product and procedures values. When unsatisfactory value is discovered, the VE job plan can be used. The job plan involves these phases:

Pre-Workshop

Before the workshop begins, a foundation is established to instill good human relations, teamwork, and management support so that an effective interaction can take place and work focuses on the specific study at hand.

- Select project and distribute to all team members
- Determine what type of project is being studied
- Determine required team to study project
- Determine major components of project needed for study
- Make sure owner, VE team and consultant designer understands VE process
- Make sure everyone is aware of the expected timeframe for results

Workshop

Information Gathering Phase

Care should be taken to gather all the pertinent data before the VE Study begins. For an example on a construction project you would:

- Secure all the facts
- Obtain latest drawings
- Obtain latest specifications
- Obtain current cost estimate
- Make site visit if appropriate
- Obtain data from designers, geotechnical, bridge, traffic, previous studies, and alternative analyses
- Determine project requirements
- Determine constraints
- Understand previous problems and attempts to resolve
- Develop a cost model and prioritize costs
- Determine completeness of original cost estimate
- Prepare and obtain answers to a value objectives questionnaire

FAST Diagramming/Function Determination Phase

- Evaluate functions and costs
- Determine basic/secondary functions
- Assign costs per function
- Develop FAST diagrams
- Determine worth of function

- Consider customer attitudes when determining functions
- Set goal for basic function costs
- Eliminate unneeded functions
- Combine functions where necessary

Creative/Speculative Phase

- Brainstorming techniques used
- All ideas should be submitted without prejudgment
- Use positive thinking
- List all ideas
- Use checklists to help
- Use imagination
- Think of similar applications that may be unrelated
- Locate where function is performed
- Can item perform dual function
- Creative techniques are used
- Three-dimensional dimensioning
- Criticizing ideas not allowed
- Accept all ideas
- Encourage freewheeling
- Atmosphere free of negative attitudes

Development/Evaluation Phase

- Combine ideas
- Refine ideas
- Develop alternative functions
- List advantages/disadvantages
- Price-out the recommended function
- Compare original to proposed methods
- Include sketches and complete description of proposed methods
- Determine how ideas would work
- Determine approximate cost of each idea
- Will ideas provide basic/secondary functions?
- Filter out better alternatives
- Quantify differences between VE team proposal and original design
- Prepare sketches for the VE team proposals and compare to original design intent
- Select evaluation criteria for matrix

Realization/Presentation/Report Phase

- Determine how idea works
- Can disadvantages be minimized or turned into advantages?
- What are total cost differences?
- Is new proposed idea better?
- Determine life cycle costs
- Document convincing facts
- Be clear and concise
- Overcome potential road blocks
- Identify additional advantages/disadvantages
- Compare proposed method to original concept
- Fine-tune proposed method to orally explain to management the new method
- Resolve issues
- Play devil's advocate to improve proposal
- Cause the responsible party to be motivated to take action to implement proposed alternatives
- Issue report to management (verbal and written)

Post Workshop: Implementation Phase

Follow-up with action plan to make sure the methods proposed are implemented. Assist with implementation plan to realize actual product improvement.

Audit the VE results to make improvement on future studies. Scrutinize response to all recommendations.

The keys to a successful VE study include:

- The phases shown above must be taken in their proper sequence.
- The FAST diagram and tabular methods are unique methods used to focus on basic functions.
- The VE objective is not only to reduce cost but also improve value without changing the intended functions.
- When these disciplined approaches are used, VE can achieve impressive cost savings that far exceed the norm of traditional cost reduction methods.

PROJECT SELECTION CRITERIA

Almost any project over $1 million can afford to have a VE study performed. Normally, the larger and more complex the project, the more opportunity there is for a greater return on investment.

For example, if the owner selected a $50 million construction project to be studied and the VE team cost to study the project was $50,000, and their findings

were $10,000,000 in potential savings (value improvement), the potential return on investment could be 200 to 1. If the owner's actual implemented savings were $5,000,000, the actual return on investment is 100 to 1.

A VE team could review projects that are large and complex at two design stages without affecting the design process as much. Those stages are normally 35% and 65%. If we wait until 90–100% complete design to study and offer value improvement solutions, the redesign costs may exceed the potential initial savings.

VE at a later stage should not be ruled out. VE change proposals (VECPs) are often submitted on a construction project to offer (or share savings with the owner) savings to the client even though the design had reached final completion.

Savings realized on one project can be multiplied when applied to every other similar project component under design.

Projects are not limited to construction to solve problems. VE is one of the most effective problem-solving methodologies used today to improve:

- Design standards
- Procedures
- Constructibility
- Performance
- Operation and maintenance
- Processes
- Time
- Value
- Worth
- Function
- Number of steps involved
- Market strength
- Future vision
- Awareness and direction of forces
- Directness from one point to another
- Company healthiness (project wise)
- Profits
- Bottom line
- Issues
- Relationships

DETERMINING VALUE

Value = function/cost. Can maximum value ever be achieved? One could achieve greater value by increasing performance and holding cost the same, or decreasing cost and holding performance the same.

WHAT ARE SOME OF THE REASONS FOR UNNECESSARY COST?

- Never having enough time
- Lack of complete information
- Lack of measuring value
- Lack of cost knowledge
- Honest wrong beliefs
- Lack of communications
- Poor human relations
- Fear of embarrassment
- Customary habits and attitudes
- Traditions/customs
- Rushing the project to completion

WHAT ARE THE RANGES OF APPLYING VE?

- VE applies to almost everything
- Everything has function
- Apparent/potential problems (VE is a good problem solver)
- Regardless of how much or little the item being studied may cost
- Can incorporate a constructibility, biddability, or maintainability review with VE workshop
- Anywhere during the design cycle or construction cycle
- Also used during the operations and maintenance phases
- Want to close the project out, try VE
- Apply before the old projects are demolished for value

7

Improving Value

PROJECT ANALYSIS

Why Take the Time to Analyze This Project?

First you may want to ask yourself or others what the project is for? What can this design do for the team or traveling public?

- When should the alteration be made?
- Where should we start when we make the improvements?
- On what part(s) of the job would we focus?
- After assigning costs to functions or functions to costs

We should discuss the worth of each function. The worth is a target. Keep in mind that it is not the group's intent to meet the target in all cases, but this type of thinking at this point generates some thought about why we need the function, how it is to be accomplished and when. It also gets everyone to participate and give his or her point of view as to how important each category of function really is to the overall project. In some cases, we might look at the function's cost and ask is it worth 50% of the pavement costs to perform that function?

During this phase we may need to quantify the target worth calculations. It brings to the team areas of potential improvement. Later, during the creative phase we can think further how each function can be potentially improved.

As part of analyzing any project, process or item under study, we would review the functions, cost, and worth. It is similar to managing a project in that

there are three key items of importance (cost, time, and performance). Except we should include value as a measure also.

When we study functions in more detail it becomes apparent that some functions are more beneficial to the overall project than others.

There are many items of importance to review, when we analyze each segment of the project and it will be the team members responsibility (expertise by area) to assist and educate the team as to the real cost that should be in the estimate for the item/function. And it is the responsibility of the professionals experienced in certain backgrounds to target the worth for particular functions. Take note though that the team leader should have some expertise in these areas to lead the team through the cost model. Often it is not apparent at first view of the cost estimate that certain costs are low or are not included. It becomes more evident that these costs are unbalanced after further review and discussion on each topic. Sometimes by reviewing the construction schedule timeframes for certain activities the costs may not match the work time and effort involved. The scope of the work may be more extensive than what has been identified in the estimate at this point. At times, the estimate may not include the costs associated with environmental permitting and other requirements that are different than what is in the database. Other areas that the estimator can pinpoint is related to factors for maintenance of traffic, mobilization, contingency, inflation, right of way, utility relocation, underground unknown conditions, cost of working at night, or shift work, stacking of trades in confined areas, cost of money, demobilization and remobilization, site access, demucking, non standard fabrication, or costs associated with state of the art materials. The list can vary depending on the type of project under study and where the project is located.

Determination of functions is very important, so important that valuable discussion time may seem to be consumed by determination of functions. When this phase is completed though, the team should have a better understanding of the project they are about to get involved with and understand the project from each other's point of view. This function analysis seems to bond the team into one coherent group joined for a common cause. For those members that are somewhat inexperienced in certain subjects this analysis serves well to get everyone up to speed.

Advantages of the function analysis is to get agreement from the group on the basic functions and to set the scope of the project we are undertaking. Certain items outside the scope lines are outside the control of this VE effort.

DEVELOPING THE FAST DIAGRAM

When diagramming the functions on a project just keep in mind the advantages. First of all let's gain an understanding of the FAST technique. Refer to Figure 1 for details.

USES OF FAST

Having the team organize specific relationships for all functions with respect to each other is very important. Assuring proper relationships between functions provides a good basis for classifying them. Arrangement of the functions can help identify missing functions. Clarification of the meaning of functions can result from the diagramming of the functions. Finding duplicate functions becomes more evident and marks those that may be eliminated or combined with others with the same result. The most basic function identified to the left inside the scope line is determined and agreed to by the group. Setting the scope lines may be arbitrary and changing the lines changes the item under study.

FAST can help avoid coming up with the right solution to the wrong problem. The team can demonstrate that a thorough analysis by this team has been made.

AVOID TRAPS

Ask how is it being done or why is it being done rather than how can it be done or why should it be done? These questions may be helpful after the original project FAST has been developed.

Those questions may be helpful after the original project FAST has been developed.

DIAGRAMMING TIPS

- List all functions as an active verb and a measurable noun
- Write the functions on small post-it notes for easy rearrangement
- Involve the whole team (excellent team building work)
- Breaks down team barriers
- Helps inexperienced team members grasp the problem
- Each team member inserts how and why each function is performed
- Everyone participates in determining the level of indenture or importance (abstraction)

In analyzing the projects it is extremely important to have the team develop the FAST diagram as a group. Review the FAST components and techniques used by the team leaders in gaining a better understanding of the project components.

Not only do we understand the project segments, more importantly we are building solid team understanding and beginning to:

- Determine design objectives
- Check for and identify missing functions
- Think ahead and identify areas of potential improvement

- Test the FAST diagram
- Use the diagram to assist with creation of first new ideas
- Change preconceptions
- Get involved parties to accept what the team has identified as their understanding of the scope and potential ways to resolve problems
- Find duplicate functions
- Help with possible elimination of unnecessary functions
- Get everyone to agree on the scope of the VE study
- More clearly segregate the basic and secondary functions
- Deepen the group understanding of the problem
- Demonstrate the teams understanding of the areas under study
- Change some functions (verb/nouns) previously identified
- Help avoid coming up with the solution to the wrong problem
- Have the group view the item under study objectively
- Pinpoint value mismatches
- Identify the current situation and contrast possible improvements
- Diagram specific components or overall concepts
- Grasp the understanding of all areas of the project
- Get the team involved
- Have the team decide on the level of detail

When identifying functions it is best to use two words (active verb and measurable noun).

DRAWING A NEW DIAGRAM

- Start with post-it notes
- Ask how
- Ask why
- If a function answers the question why place it on the left
- Place the function on the right if it answers how
- If the function happens at the same time it falls below the function
- Determine the critical path functions
- The most basic function is immediately inside the left scope line
- May want to ask the question, if we didn't have the function could we still perform the other functions?
- Scope lines of the item under study (refer to the diagram above)
- Review the high cost/worth areas along with the verb/noun functions
- Higher order function is outside scope line to the left
- Lower order or causative function is outside the scope line on the right

Divide into teams and develop a FAST diagram for a specific item, what is the basic function?

Begin to think how the item could be improved, combined, eliminated, or reduced. One person should be the leader of the FAST diagram solution.

8

Value Project Analysis Criteria

Standards are available for managers of value objectives, below is a modified version of the ASTM value analysis (VA) guideline used mostly for buildings/construction projects.

VM STANDARDS

Value Analysis Practice Guidelines

Adapted from: DOD, FHWA and FDOT, ASTM-E1699-95 VE Guidelines.

SCOPE

This practice covers a procedure for defining and satisfying the requirements of the user's/owner's project. A multidisciplinary team uses the procedure to convert design criteria and specifications into descriptions of project functions and then relates these functions to revenues and costs.

Examples of costs are all relevant costs over a designated study period, including the costs of obtaining funds, designing, purchasing/leasing, constructing/installing, operating, maintaining, repairing, replacing and disposing of the particular building design or system. While not the only criteria, cost is an important basis for comparison in a value analysis study of a building. Therefore, accurate and comprehensive cost data is an important element of the analysis.

This is a guideline to develop alternatives that meet the project's required functions. Estimate the costs for each alternative. Provide the user/owner with specific, technically accurate alternatives, appropriate to the stage of project de-

velopment, which can be implemented. The user/owner selects the alternative(s) that best satisfies his needs and requirements.

Apply this practice to an entire project or to any subsystem. The user/owner can utilize the VA Guidelines to select the element or scope of the project to be studied.

SUMMARY OF PRACTICE

This practice outlines the guidelines for developing alternatives to a proposed design that best fulfills the needs and requirements of the user/owner of the project or system. The practice shows how to identify the functions of the project and its systems; develop alternatives to fulfill the user's/owner's needs and requirements; and evaluate the alternatives in their ability to meet defined criteria.

SIGNIFICANCE AND USE

Perform VA during the planning, design, and construction phases of a building. The most effective application of VA is early in the design phase of a project. Changes or redirection in the design can be accommodated without extensive redesign at this point, thereby saving the user/owner time and money.

During the earliest stages of design, refer to value analysis as value planning. Use the procedure to analyze predesign documents, for example, program documents and space planning documents. At the predesign stage, perform VA to define the project's functions, and to achieve consensus on the project's direction and approach by the project team, for example, the owner, the design professional, the user, and the construction manager. By participating in this early VA exercise, members of the project team communicate their needs to other team members and identify those needs in the common language of functions. By expressing the project in these terms early in the design process, the project team minimizes miscommunication and redesign, which are costly in both labor expenditures and schedule delays.

Also, perform VA during schematic design (up to 15% design completion), design development (up to 45% design completion), and construction documents (up to 100% design completion). Conduct VA studies at several stages of design completion to define or confirm project functions, to verify technical and management approaches, to analyze selection of equipment and materials, and to assess the project's economics and technical feasibility. Perform VA studies concurrently with the user's/owner's design review schedules to maintain the project schedule. Through the schematic design and design development stages, the VA team analyzes the drawings and specifications from each technical discipline. During the construction documents stage, the VA team analyzes the design drawings and specifications, as well as the details, and equipment selection, which are more clearly defined at this later stage.

A VA study performed at a 90 to 100% completion stage, just prior to bidding, concentrates on economics and technical feasibility. Consider methods of construction, phasing of construction, and procurement. The goals at this stage of design are to minimize construction costs and the potential for claims; analyze management and administration; and review the design, equipment and materials used.

During construction, analyze value analysis change proposals (VACPs) of the contractor. VACPs reduce the cost or duration of construction or present alternative methods of construction, without reducing performance, acceptance, or quality. At this stage the alternatives presented to the user/owner are VACPs. To encourage the contractor to propose worthwhile VACP's the owner and the contractor share the resultant savings when permitted by contract.

The numbering and timing of VA studies varies for every project. The user/owner, the design professional, and the value analyst determine the best approach jointly. A complex or expensive facility, or a design that will be used repeatedly warrants a minimum of two VA studies, performed at the predesign and design development stages.

VA TEAM

The value analysis team leader (VATL) plays a key role in the success of a VA study and is responsible for managing all aspects of the effort. A VA team leader needs training in value analysis and experience as a team member, leader, or facilitator on previous studies.

The size and composition of the VA team depends on the project being studied and the stage of design development. Select persons of diverse backgrounds having a range of expertise and experience that incorporates all the knowledge necessary to address the issues the VA team is charged to address.

Select technical disciplines for a VA team that are similar to the technical disciplines on the design team for the stage of completion being reviewed. Include professionals who are knowledgeable in the financing, cost, management, procurement, construction, and operation of similar building or systems.

The user/owner decides whether to create the VA team using members of the project team, that is, (the user/owner, the planner, the design professional, and the construction manager) or using professionals who have not been involved in the design and have no preconceived ideas.

The user/owner and the VATL agree upon the team composition. Determine the duration of each team member's participation based upon the design completion stage, the amount of information available to the VA team, and the interrelationship among the disciplines.

Decisions reached from the standpoint of one discipline frequently have a major impact on the approach the designer will take for another discipline. Thus, the multidisciplinary interaction is necessary. The collective knowledge and experience of the multidiscipline team create the synergy that helps this procedure to

be successful. The team is dynamic, marked by continuous productive activity, which promotes positive change. Individual personalities are important to the success of the VA team, as well. Positive attitudes, technical knowledge, education, and experience are important to the outcome of the study.

Make final the team composition and level of participation after receiving the project documents and knowing specifically what information is available for the workshop effort.

GUIDELINES

A value analysis study has three sequential periods of activity—preparation effort, workshop effort, and post-workshop effort. Within these activities, the VA team follows a formal plan, as shown below, and as described in the following:

Pre-Workshop Effort:
Develop study scope
Select project/team
Select study location
Gather information for team to review
Set a tentative agenda for study activities
Arrange for part-time members at appropriate times

Workshop Effort:
Information phase
Function and analysis phase
Creative phase
Evaluation phase
Development phase
Presentation phase

Post-Workshop Effort:
Implementation phase

PREPARATION EFFORT

The VA team prepares for the workshop effort to ensure that events are coordinated; that appropriate information is available for the VA team to review; and that the design professional is prepared to present a description of the project on the first day of the workshop.

The design professional is an integral part of the value analysis process, whether the design professional participates throughout the process, or becomes involved at specific milestones. The VA team is only effective when it communiates with the design professional and the user/owner, and presents alternatives for their consideration.

Preparing for the workshop effort, the VATL coordinates the VA study schedule with the design professional and the user/owner to accommodate the project schedule.

The VATL, the user/owner, the design professional, and the construction manager, as appropriate, meet to discuss the scope of the workshop, the objectives of the workshop, and the constraints that have been imposed on the project by the user/owner or regulatory agencies.

The user/owner, the design professional, and the construction manager, as appropriate, establish performance and acceptance requirements for evaluating alternatives during the evaluation phase of the workshop effort. They select these criteria from items such as initial construction cost, life-cycle cost, aesthetics, ease of operation and maintenance, safety, and schedule adherence.

The user/owner, the VATL, the design professional, and the construction manager, as appropriate, determine the need for a site visit by one or more team members and establish the schedule for this tour. If the workshop effort is not going to occur near the project site, it is appropriate to schedule this effort prior to the workshop effort.

The VATL collects the project study material from the design professional. Examples of information needed from the design professional include, but are not limited to:

- Owner's design standards
- Design criteria
- Project budget
- Design calculations
- Alternatives considered
- Technical memoranda, as appropriate
- Permit requirements
- Regulations governing construction
- Maintenance requirements
- Equipment data sheets
- Estimate of construction cost
- Quantity take-off
- Applicable building codes
- Architectural concepts
- Construction phasing
- Soil borings
- Operations requirement
- Project schedules
- Pre-purchase and accelerated purchase documents

Using the most current, preliminary estimate presented by the project team, the VATL develops the capital cost model, which organizes initial construction

costs by element and trade to determine where high costs are expended. Display the estimated construction costs graphically on this cost model by system and subsystem. The VA team will use this cost model during the workshop effort to assign target initial construction cost estimates for each element and trade.

With information provided by the user/owner and the design professional from historical data or projected energy consumption, the VATL or a knowledgeable team member designated by the VATL, prepares an energy model to display energy consumption for the building system, subsystem, or functional area. The model visually identifies energy intensive areas. Prepare an energy model for projects that present a potential for high-energy consumption. The VA team assigns target energy consumption estimates during the workshop effort.

With information provided by the user/owner and the design professional from historical data or projected life-cycle costs, the VATL, or a knowledgeable team member designated by the VATL, prepares a life-cycle cost model to display the total cost of ownership for the building system, subsystem, or functional area. The model identifies the high cost areas of ownership. The user/owner and design professional establish the interest or discount rate to be used in the analysis. This rate is the same as that used by the design professional during the design process. The VA team assigns target life cycle cost estimates during the workshop effort.

The VATL distributes project information to the VA team members who review the documents and prepare for the study. The VATL prepared a sample format for a presentation by the design professional at the beginning of the workshop effort. Topics that the design professional addresses includes, but are not limited to:

- Scope of the project team's effort
- Participating firms
- Existing site conditions
- Regulatory requirements
- Basis of design
- Rationale and steps in the development of design
- Planning concepts
- Method of operation
- Pertinent information from public participation
- Constraints
- Applicable codes
- Explanation of information provided by the project team
- Summary of cost estimate
- Construction phasing

The VATL can arrange for the workshop logistics, accommodations and transportation for the VA team members. Before the workshop, the VA team members familiarize themselves with the project documents.

WORKSHOP EFFORT

Information Phase

The design professionals present the project to the VA team. The team members use this opportunity to ask questions arising from review of the project documents during the preparation effort. Following the presentation, the VA team or specific members visit the project site, if appropriate, establish target costs for the cost, energy, and life-cycle cost models, and begin the function identification and analysis.

Using the cost model that the VATL prepared during the preparation effort, the VA team develops target estimates for each system and subsystem or functional grouping; and establishes these targets based on its collective experience as the least cost necessary to perform the function. Areas that show a significant difference between the design professional's cost estimate and the target estimate are those that present opportunities for improvement.

In evaluating a project that presents a potential for high energy usage, the VA team, as directed by the VATL, develops target energy consumption estimates for each system, subsystem, or functional grouping using the energy model prepared during the preparation effort; and establishes these target estimates based on its collective experience as the least energy consumption necessary to provide the function. Areas that show a significant difference between the projected energy consumption and the target energy consumption estimate are those that present opportunities for improvement.

In evaluating a project that has a potential for high life-cycle costs, the VA team, as directed by the VATL, develops target life-cycle cost estimates for each system, subsystem or functional grouping using the life-cycle cost model prepared during the preparation effort; and establishes these target estimates based on its collective experience as the least cost of ownership necessary to provide the function. Areas that show a significant difference between the user's/owner's projected life-cycle cost and the target life cycle cost estimate are those that present opportunities for improvement.

Function Identification and Analysis Phase

Analyzing functions is the critical activity in value analysis. Perform function identification and analysis in the multidisciplinary team session. Identify and define the functions of the building project or subsystem; then define the functions of each building element using an active verb and a measurable noun.

Classify the functions of each element as basic (essential to meet the user/owner needs and requirements), or secondary (supporting functions that enhance user/owner needs and requirements). The basic functions must be fulfilled in any alternative. The secondary functions describe features, attributes, or approaches that implement or enhance the basic functions.

After defining the functions of the project, relate these functions to cost. As in preparing the cost model, use the cost information from the design professional's cost estimate to assign a cost to each function.

The VA team then collectively sets a target cost, or the worth, for each function. This worth is the team's estimation of the least cost (initial cost, presented in same terms as the design professional's cost estimate) required to perform the specific function. It represents a target for the team to obtain the necessary functions. The team determines the worth figures based upon their experiences on similar projects. During this process, the team will naturally begin to develop creative ideas.

Total the design professional's costs for each system or functional group. Total the VA team's worth estimates for the basic functions of the same systems or function groups. Divide the design professional's cost for each system or functional group by the basic worth to calculate the cost-to-worth ratio. A ratio greater than 1:1 indicates an opportunity for cost improvement. The greater the ratio, the greater the opportunity for improvement. The VA team concentrates on those opportunities during the next phase of the workshop, the creative phase.

Compare the results of the function analysis to those of the cost model. Corresponding systems or subsystems will show equivalent cost-to-worth ratios and present additional areas in which the team will concentrate to meet the needs and requirements established by the user/owner for cost, performance, and reliability of the element being studied.

Creative Phase

Use one or more of the creativity methods (see Chaps. 15 and 30) for stimulating creativity to develop a list of ideas for possible solutions for the functions defined in the preceding phase, without regard to cost. Encourage a free flow of ideas. Suspend judgment.

From the ideas presented, create alternatives. Each alternative must satisfy the basic functions of the project and perform to some degree the secondary functions.

Evaluation Phase

List the criteria for evaluation that were established during the preparation effort. List each alternative's advantages and disadvantages. Using any generally accepted ranking procedure, rank each idea on both how well it meets the criteria and on how well it performs the required functions. Do this evaluation as a team.

If none of the alternatives performs every criterion satisfactorily, return to the creative phase. Using the knowledge gained in evaluation, create new alternatives.

Development Phase

Beginning with the highest ranked ideas, prepare alternatives for change. Determine the feasibility of each alternative, appropriate to the stage of project development. Discard those alternatives that do not work. Combine ideas, as appropriate. Develop variations to specific alternatives that have multiple approaches.

Estimate the costs of the best alternatives. Provide as much technical information on the alternatives as practical in the VA workshop, so the design professional, at the conclusion of the workshop, can make an initial assessment concerning their technical feasibility and applicability to the design.

Support each alternative with:

1. Written descriptions of the original concept and the proposed alternative.
2. Sketches of original design and proposed alternative.
3. Technical backup, including but not limited to calculations, catalogue cuts and vendor information.
4. Advantages and disadvantages of the alternative.
5. Discussion of the alternative to clearly communicate the idea to the reviewer, including information about implementation, for example, cost, schedule, potential conflicts.
6. Cost information, including initial and life cycle cost estimates, as appropriate, which clearly display the differences between the original design costs and the alternative's costs.

Present, as design comments, alternatives that are not accompanied by cost data, due to a lack of time or information.

Presentation Phase

Communication is essential to the success of a VA effort. Therefore, conduct a meeting on the last day of the VA workshop during which the VA team presents each of its alternatives to the design professional, user/owner, or other involved groups or individuals, so they understand the intent of each alternative before they begin the in-depth evaluation determining implementation.

Prepare a written report if desired by the user/owner. At a minimum, present the alternatives with supporting documentation and potential cost savings. Establish a specific date for submittal of the report so implementation begins without delay.

Report the following information:

1. Project objectives
2. Project description

3. Scope of analysis
4. VA procedure
5. Value analysis alternatives and associated cost savings

POST-WORKSHOP EFFORT

Implementation Phase

Ensure that implementation will occur by developing an implementation plan and schedule, assigning responsibility for implementation activities to a specific individual, and establishing a monitoring system.

The implementation method varies on every project. The user/owner determines responsibility and assigns it to the design professional, the value analyst, the construction manager or himself.

The design professional and the user/owner review the proposed alternatives independently and determine the applicability of each alternative. The design professional and the user/owner meet to decide the final disposition of each alternative. The user/owner directs the design professional to implement those alternatives that best meet his needs and requirements, or directs the design professional to perform further analysis to determine the feasibility of implementing specific alternatives that appear to meet the needs and requirements but do not, at that time, need further analysis to verify implementation possibilities.

The design professional documents the reasons why specific alternatives have not been implemented. Some examples are as follows: the acceptance of one alternative will preclude the acceptance of another; or after further analysis, the design professional learns that an alternative is not technically feasible; or of several options presented that are comparable in cost, performance or aesthetics, one is simply more pleasing to the user/owner.

In all cases, the design professional is responsible for determining the technical feasibility of an alternative. Each alternative must be independently designed and confirmed before its implementation into the project design.

9

Pre-Study Work Plan

As part of the pre-study work plan the team leader would prepare an agenda (a typical agenda a team may use during the MVO study is shown in Chap. 13). It is good practice to set up an agenda of the work plan for each study. The specific project, process, program, product, system, or technique would be determined for the team to study. Team members should be selected and assignments outlined before the study begins.

Selection of project specific materials to be studied by the team should be gathered and distributed to the team members before the beginning of the study. Major areas of study focus should be determined. The major functions should be determined as well as any constraints that would affect areas of the study.

Make sure the owner, VE team, and consultant designer understand the VE process being undertaken and the expected timeframe for results

LOCATION

It is best for the team to conduct their study as close to the item being studied as possible. Other locations can be used but if held near the location under study then the team could get answers to many questions that arise during their study.

TEAM SELECTION

The VE team usually functions well when the professionals are dedicated to the VE process. Recruiting a team is like drafting key players for a professional sport. Members are selected based on:

- Project requirements
- Professional disciplines needed
- Ability to perform with a team
- Demonstrated knowledge in expertise
- Availability
- Experience with similar projects
- Not currently part of the design team
- Familiarity with the scope
- Ability to follow job plans

It would be nice to have team members with some of the following personal qualities:

- Organized
- Neat
- Accurate
- Outgoing
- Self-confident
- Reliable
- Excellent communicator
- Idea generator
- Curious
- Tenacious
- Balanced
- Fastidious
- Accountable
- Can take action
- Responsible
- Trustworthy
- Committed
- Ability to follow instructions
- Ability to meet short schedule
- Handle authority
- Facilitator
- Nonprocrastinator
- Not fearful

In addition to the traits listed, the team member should also be able to wear several hats during the VE study. He/she must be a:

- Team worker
- Innovator
- Monitor–evaluator
- Astute worker (uncomfortable with vague ideas)
- Resource investigator (contact w/outside world)
- Completer (keeps team on track and on schedule)

Usually the team flows through four separate stages as they follow the 5-step VE job plan. The four team stages are:

1. Form (test the nature of the situation)
2. Storm (engage in conflict, demonstrate polarized opinions)
3. Norm (develop group cohesion)
4. Perform (structured activities leading to solutions)

You can see that this team flow can be used to accomplish the five-step VE job plan:

1. Information (form)
2. Function (storm)
3. Creative (storm)
4. Development (norm and perform)
5. Realization/Presentation/Report (perform)

The VE team leader can facilitate and develop a common approach to help the members complete each phase and concentrate to meet the goals.

The team becomes more effective when they have:

- A clear purpose
- Interdependence—rely on each other to meet the team goals
- Commitment to work as a team and not isolated individuals
- Group effective benefits that outweigh customary everyday ways of doing things
- Needs of the team require significant interaction among team members and coordination of matters such as planning, problem solving, and decision-making

Some guidelines for keeping the VE team on track include:

- Clear about team objectives
- Everyone agrees on the 5-step job plan methodology
- Encourage open and honest discussions
- Keep the team's actions closely related to the team goal
- Be realistic about time required for the work to get effective results
- Do not raise expectation above the level that the team can meet

Healthy team qualities include:

- Optimal use of resources
- Group understands why it does the VE study
- Agreement within the group about ultimate goals
- Team has ability to act on its own outcome
- Ability to quickly assimilate new information and render its opinion
- Everyone has influence of team decision-making

MOTIVATION

Goals can be met if the VE team intentionally desires to do so. Goals should be obtainable, specific, challenging, and committed to by the individuals. Feedback should be given for attainment of intermediate and overall goals.

Goal setting combined with on-going feedback and appropriate incentives can be effective in increasing the motivation to perform well. Appropriate incentives vary from meeting challenges to convincing the client of a better way.

Another motivating factor is the ability of the team leader to bring available resources to the study that enables their goals to be met. As the study progresses, the team leader is able to give valid feedback based upon the measurement of attaining goals set for each phase.

Specific feedback can be a motivator. Such as, "Mr. X, you did a good job in the presentation to the client today."

CONFLICT MANAGEMENT

Conflicts happen. Sometimes it is unavoidable. Conflict may seem negative but can be beneficial in a team setting.

- When expressed verbally, conflict can create energy that can be directed positively
- It gets feelings out in the open where they can be handled
- Confidence can be built because of the knowledge that the relationship can survive a disagreement

- It can promote genuine contact so that you deal with one another's feelings
- It can increase cohesiveness
- It can increase productivity
- It can lead to a real consensus
- It can lead to team growth
- It can lead to critical issue identification on the project
- It can lead to action initiation
- It can get problems resolved
- It can promote personal growth
- It allows opportunities (nothing ventured nothing gained)
- It can lead to professional recognition since this team can effectively manage difficult situations

10

The Job Plan

Information gathering occurs in the beginning of the job plan followed by many MVO study teams. During information gathering the team will confront many cost modeling pitfalls and the team will need to verify the cost estimate given for them to study.

- Usually 80% of the costs are in 20% of the items
- Costs are to be modeled for all major function areas of the project
- By taking the cost for a typical project the group may model the costs
- Determine what costs are missing
- What costs appear low or high
- Include the cost for unknowns
- Quantities may need to be checked and reviewed

Prepare parametric costs for comparison to the current estimate. Parametric cost example: Normally, the cost/square of yard of pavement may be compared to the actual estimated cost (for example, the parametric cost/sq yd of pavement may be $10/sq yd, but when compared to the actual estimated cost/sq yd, it is determined that the actual cost/sq yd is $24/sy, which may be high and an area for the team to focus).

Use the information from the instructor's handout and sketch for the project and develop a cost model for the project broken down by major function area, (i.e., earthwork, drainage, lighting, etc.)

After each cost model has been prepared determine the parametric costs

(costs from similar projects, i.e., costs per square yard for pavement). As needed, confirm the quantities for the function areas.

The following value engineering terms are commonly used.

FIVE-STEP JOB PLAN

The structured job plan technique is very helpful in providing for assessment and evaluation of product and procedure values. When unsatisfactory value is discovered, the value engineering job plan can be used. The job plan involves these phases:

PRE-WORKSHOP

Before the workshop begins, a foundation is established to instill good human relations, teamwork, and management support so that an effective interaction can take place and work focuses on the specific study at hand. The steps include:

- Select project and distribute to all team members
- Determine what type of project is being studied
- Determine required team to study project
- Determine major components of project needed for study
- Make sure owner, MVO team and consultant designer understand the MVO process being undertaken and the expected timeframe for results

WORKSHOP

Information Gathering Phase

Care should be taken to gather all the pertinent data before the MVO study begins. For a construction project, for example, you would:

- Secure all the facts
- Obtain latest drawings
- Obtain latest specifications
- Obtain current cost estimate
- Make site visit if appropriate
- Obtain data from designer's, geotechnical, bridge, traffic, and previous studies, and alternative analyses

- Determine project requirements
- Determine constraints
- Understand previous problems and attempts to resolve
- Develop a cost model and prioritize costs
- Determine completeness of original cost estimate

FAST Diagramming/Function Determination Phase

- Evaluate functions and costs
- Determine basic/secondary functions
- Assign costs per function
- Develop FAST diagrams
- Determine worth of function
- Consider customer attitudes when determining functions
- Set goal for basic function costs
- Eliminate unneeded functions
- Combine functions where necessary

Creative/Speculative Phase

- Brainstorming techniques used
- All ideas should be submitted without pre-judgment
- Use positive thinking
- List all ideas
- Use checklists to help
- Use imagination
- Think of similar applications that may be unrelated
- Locate where function is performed
- Can item perform dual function?
- Creative techniques are used
- Three dimensioning
- Criticizing ideas not allowed
- Accept all ideas
- Encourage freewheeling
- Atmosphere free of negative attitudes

Development/Evaluation Phase

- Combine ideas
- Refine ideas
- Develop alternative functions
- List advantages/disadvantages
- Price-out the recommended function
- Compare original to proposed methods
- Include sketches and complete description of proposed methods determine how ideas would work
- Determine approximate cost of each idea
- Will ideas provide basic/secondary functions?
- Filter out better alternatives
- List advantages/disadvantages
- Select evaluation criteria for matrix

Realization/Presentation/Report Phase

- Determine how idea works
- Can disadvantages be minimized?
- What is total cost?
- Is new proposed idea better?
- Determine life cycle costs
- Document convincing facts
- Be concise
- Overcome road blocks
- Identify additional advantages/disadvantages
- Compare proposed method to original concept
- Fine-tune proposed method to orally explain to management the new method
- Resolve issues
- Play devil's advocate to improve proposal
- Cause the responsible party to be motivated to take action to implement proposed alternatives
- Issue report to management

TENTATIVE AGENDA

Project: To be Determined

The agenda for the formal 5 day MVO study is as follows, assuming the information is being transmitted to the team before the study:

Day one	Kickoff/Intro by MVO team leader
	Questions for designer
	Designer orientation
	Summarize project constraints
	Begin cost model
	Site review
	Summarize site review
	Finish cost/function chart
Day two	Function analysis
	Intro to creative thinking
	Creative idea listing/function
	Creative idea listing/function complete
Day three	Evaluation phase midpoint review with client
	Begin development phase
	Determine economic factors
Day four	Continue development
Day five	Finish development
	Prep for oral presentation
	Oral presentation-MVO study findings to client

MVO studies will include tasks associated with the following specific phases:

- Pre-study activities phase
- Conduct MVO study phase
- Post value study phase

This project approach has been used successfully on the improvement of over 240 projects, products, programs, processes, systems, and techniques by the teams. For some agencies this approach is being used on over 120 projects each

year. This approach both in preparations for and during the workshop allows sufficient time to maintain a quick turnaround time for the project study and the submittal of a MVO report. The approach also assures owner, user, architect/designer and project manager participation during the study. It takes advantage of the owners' and users' past experiences and urges their full involvement in the analysis of the project.

PRE-STUDY ACTIVITY PHASE

Prior to beginning the pre-study activity phase the MVO project manager will assist the client project manager with narrowing a selection of projects to be used for study during the upcoming year.

Communication and coordination of the MVO effort are vital aspects of the study's success. Of prime importance in the pre-study activity phase is the development of a rapport among the architect/designer, the user, the owner and the program manager (the project team), who are integral parts of the effort. Each participant recognizes that his or her responsibility/involvement in the MVO effort is as important as the MVO team and understands that the main goal of the study is to yield a better project through teamwork. The aim is to supplement the project team's work in order to arrive at a better end product.

Because the study is an abbreviated effort, the MVO consultant must become familiar with the project in a short timeframe. Therefore, this pre-study activity time is used to educate the team members about the history of the project and to define the issues. The project data is collected via a value objectives questionnaire and distributed for comment prior to the formal workshop session. The advantage to this approach is that the MVO team members become familiar with the documents and are able to develop relevant questions for discussion. There is opportunity on the first day of the workshop, following the architect/designer's presentation, for discussion and questions with the project team.

It is imperative that the MVO team understands what is important to the owner and the user in completing the complex task of planning, designing and constructing the project. This is accomplished via dialogue with the owner and members of the project team.

Understanding the owner's specific value objectives will give the team the tools needed to evaluate ideas for change. The results of the value objective questionnaire will be provided to the MVO team at the onset of the workshop for use in the evaluation process. The Value Engineering team leader will review the procedure to be employed in the evaluation of the creative ideas generated by the MVO team.

A description of a pre-study activity phase list is as follows:

- Arrange for the identification and collection of project study material.
- Coordinate the MVO study schedule with the architect/designer and the owner to best suit the overall project schedule.
- The MVO team leader, owner and members of the project team discuss and complete the value objectives questionnaire.
- Develop project capital cost, energy and life cycle cost models, as appropriate. These models organize initial, energy and LCCs by system and trade to determine where high consumption and costs are expended.
- Distribute background information on the project design to the team members in preparation for the study.
- Prepare the format for presentation by the architect/designer to assist the MVO process.
- Obtain information on the project from the owner, the user, the program manager, and the architect/designer.
- The project coordinator will arrange the study logistics, accommodations and transportation for the MVO team members
- The project team will provide all materials required to perform and conduct the study.

Information to be supplied by client for use during the MVO study (example):

- Drawings and aerial photo coverage of the planned project.
- Identification of a preferred concept, which includes construction cost, estimates, quantity of items to be constructed, environmental impacts, safety considerations, operations, and maintenance of traffic phases, relocations, and construction schedule duration by phase.
- Approved technical specifications.
- Equipment listing with sizes and energy usage requirements.
- Estimated construction cost breakdown by alternate.
- Estimated costs for each alternate (broken down into labor, material, equipment, subcontract, with separate costs for contingencies, overhead and miscellaneous.
- Construction schedule.
- Life cycle cost data that includes maintenance cost, periodic improvements, and resurfacing requirements for each alternate.
- Key sheet with location map.
- Pertinent regulations.
- Conceptual structural plans including bridge development reports.
- Geotechnical reports.
- Suggested supplemental specifications.
- Plans and interface scheme with adjacent work by others.

All VE studies shall be completed in accordance with all applicable client procedures, design standards, guidelines, project preparation manuals, project manager guidelines, and the desires of the client made known to the MVO consultant.

A primary focus in the pre-study activity phase is that all parties are well coordinated regarding the progress of the project; that there is ample information available for the MVO team; and that the architect/designer is prepared to present the description of the project on the first day of the workshop. Before the study begins each member will receive an agenda of the activities to be performed for the study.

CONDUCTIVE STUDY PHASE

VE is a systematic team approach for searching out high cost areas on a project and arriving at the best project at least overall cost without sacrificing functions. It is not a design review. The previous mentioned agenda is a basic one used for the 40-hour study. It requires the proper positive attitude and removal of mental roadblocks that can thwart creative thinking.

The project design team will give a presentation regarding the rationale for the design to the MVO team on the beginning of the first day of the study. This brief presentation by the current designer will provide additional information and provide answers to team questions prior to offering new ideas for the MVO study.

INTRODUCTION

- MVO team leader introduces study participants and explains project orientation
- Design team presents the project description
- The design team, the owner, and the MVO team leaders outline the project constraints for the MVO team
- Team members ask questions

The following phases will be used to conduct the study:

INFORMATION/INVESTIGATION GATHERING PHASE

The MVO team members familiarize themselves with the contract plans and specifications in conjunction with the capital cost, right of way/maintenance/construction/energy and life cycle cost (LCC) models. They determine factors, which influence the cost and perform the function analysis of the project to justify each component and determine its functional requirements. Starting with each project element, the team will define its function and classify it

as primary (basic required), or secondary (not necessarily required). The secondary functions will be further classified as critical or noncritical to the performance of the primary functions. After analyzing the major project elements, the MVO team will analyze in the same manner each of the items that comprise the element. This information will be used to assess the worth of performing the function, and identify high cost/low worth elements of the project. The worksheets used in this phase are the Cost Model, Energy Model, LCC Model, and Function Analysis worksheets.

The MVO team leader and client project manager will determine the pertinent project documents needed for each study, and will provide these to each MVO team member prior to beginning the MVO study. The MVO team members will carefully study the documents and investigate the project. During this initial phase, the MVO team members will develop questions for the project design team.

The project design team will apprise the MVO team of client project components, scope, design criteria, program requirements, and point out any project constraints.

The MVO team will bring to the study location any reference documents and phone numbers they may need for potential recommendation development.

The client's project manager and the MVO team leader will explain the MVO study project objectives, identify the project design criteria, and verify all of the valid project constraints. The MVO team will then prepare a cost model using the project cost estimate. The cost models will include initial and future costs. The team will also develop and use a graphic model to clearly indicate major areas where they should focus their efforts.

ANALYSIS OF FUNCTIONS SPECULATION PHASE

The MVO team begins listing their creative ideas. The aim is to obtain a large quantity of ideas by eliminating roadblocks to allow a free flow of thought. The team may use checklists from previous studies. In this segment of the workshop, the team uses the creative idea listing/judgment worksheet.

The MVO team will use the cost model to develop the FAST diagramming in order to understand the basic and secondary functions. The team will also obtain an understanding of secondary and supporting functions.

By defining the functions, the team is better able to determine precisely which characteristics of the study area are really required. The objectives of this phase are to define, identify, classify, and determine the value (worth and cost) of the functions of the project components.

The MVO team will document the team's determination of the functional components (cost/worth ratios). The team will answer questions about the cost and value of the project.

The team will focus their time on major cost items and determine:

- What is the cost of the function?
- Does it cost more than it is worth?
- Has worth been established for each function?
- Are functions necessary?
- Is there a better way to perform the same function?
- What does it do unnecessarily?
- Have operations and maintenance costs been identified?
- What are client requirements?

The team will brainstorm to generate creative alternative ideas for accomplishing necessary functions. The team is encouraged to submit any and all ideas during this phase. The team will speculate about alternates and use checklists or previous ideas when the team seems to have become stagnant on offering new ideas.

- What else can perform the same function?
- Where else can the function be performed?
- Can items be combined?
- Can the item be modified, condensed?

In addition, the team is encouraged to be imaginative, list everything, defer judgment, not criticize, not be intimidated, and not prejudge anyone else's ideas.

The MVO team leader will provide techniques for the team that emphasizes the importance of positive interpersonal relations in the success of any effort. The MVO process challenges and questions people about ideas and designs that they are strongly committed to. This requires that each member put forth a conscious effort to maintain good relations.

The following guidelines, as practiced by our team leaders, promote positive interpersonal relations:

- Acquaint people with the MVO study procedure
- Promote MVO as a team effort
- Respect each other's ideas
- Try looking at the study from other vantage points
- Report findings as clearly and concisely as possible
- Be careful in handling or making proposals
- Always have the facts to back up the recommendations
- Present the recommendations clearly and concisely
- Listen carefully (listen for what is not being said)
- Consult with others about recommendations

The MVO team leader will provide the team with life cycle cost techniques. The team will consider the assumed useful life, recycle costs, maintenance costs, environmental concerns, replacement costs and energy costs.

EVALUATION PHASE

In the evaluation phase, the creative ideas that were generated in the previous phase are further analyzed by discussing the apparent advantages and disadvantages of each idea. The team's rating/ranking method for each idea is determined using a matrix method that forces consideration of factors affecting the acceptability of each idea, such as:

- Constructibility
- Maintainability
- Redesign time
- Initial cost savings
- Life cycle cost, savings
- Chance for owner's acceptance
- Recycling
- Production time
- Delivery time
- New technology owner's preference
- Aesthetics
- Simplicity
- Bidding requirements
- Flow rates and patterns
- Agency approval
- Weather
- Utility relocation
- Conflicts
- Hazardous operations review
- Service requirements
- Safety
- Proximity to site
- Consistent installation requirements
- Vendor availability
- Data transfer

After rating the ideas, each highest-ranking recommendation is then further developed.

The MVO team analyzes the ideas listed in the creative session and selects the best ideas for further development. The listing of ideas is reviewed with the design team to discuss the advantages/disadvantages in order to rank the ideas and to benefit from the design team's point of view on the project. The creative idea listing/judgment worksheet and the evaluation matrix are used here.

Up to this point in the MVO study, the primary emphasis is on the cost of each recommendation. Using a weighted analysis, the MVO team may analyze other pertinent factors including aesthetics, initial and operating costs, safety, maintainability, operational reliability, and other areas, which are appropriate to the project.

DEVELOPMENT PHASE

MVO team members prepare alternate designs for consideration with life cycle costs (LCC) comparisons of the original designs and proposed alternatives. All recommendations will be backed up with written descriptions, sketches, basic design concepts, technical backups, and recommendations of alternatives and LCC summaries. During the development phase, the team uses the recommendation, LCC, operation and maintenance, and cost estimate worksheets.

Each recommendation is documented according to client requirements. Each recommendation will compare the method in the original design to the method the MVO team recommends. The development will clearly and concisely explain the recommendation and include justification, advantages, disadvantages, detailed cost estimates, schedule impacts, potential cost reductions and improvements, a sketch contrasting original to proposed design, and life cycle costs that need to be considered.

Presentation/Reporting Phase

At the conclusion of the MVO study the value MVO study results will be presented to the client in accordance with SAVE International multi-step job plan, with the study summary prepared in a format consistent with approved client procedures and approved by the clients project manager.

The MVO team will support the MVO recommendations with sufficient detail and calculations to allow a prudent decision of implementation. In addition the study summary shall contain an executive summary, which discusses in detail the MVO team recommendations and the advantages and disadvantages of the proposed MVO alternatives, as well as the potential life cycle cost savings. The teams certified cost consultant prior to submitting the figures to the client will review the cost savings. The MVO study will also discuss the cost and time in-

volved of any redesign, environmental impact, manpower requirements, and time involved modifying program plans.

The required copies and the original MVO study report will be furnished to the client within a short period after the last day of the study to allow for prompt implementation of the recommendations.

The MVO team prepares a summary of their findings for verbal presentations to the client, the user, the architect/designer, the program manager and the regulatory agencies (if required). The basic ideas recommended by the MVO team is summarized and the LCC savings presented. The MVO team will present the rationale for each recommendation, along with the background information used to form the idea. In addition, the MVO team will work with the owner and the design team in accepting and rejecting recommendations in order to develop an approach to the project design. The idea presentation session is not intended to be a design critique, but rather a sharing of information and an exchange of knowledge.

At the conclusion of the MVO study, the MVO team will make an oral presentation to client, architect/engineer designer of record, and other agencies as required. The MVO team leader will provide a draft written report, and after the designer's response is received, the MVO team leader will provide a final MVO report.

In addition to the oral presentation conducted during the MVO study, the CVS and such team members as deemed necessary by the client value engineer shall make a formal presentation to client management. The presentation shall be coordinated through the client's project manager to ensure that persons authorized to evaluate and act upon the value engineering recommendations are present.

Upon completion of the MVO workshop, the MVO team leader will submit the MVO study report to client. The recommendations from the MVO team to the design team are to be completed and prepared in a timely manner so the design effort will not be impacted.

The report will include:

- Executive summary
- Project goals and objectives
- Program/project description
- Scope of analysis
- MVO methodology/cost model/ideas listing/functional analysis/evaluation/development forms
- Summary of MVO recommendations and associated potential cost savings

In addition, the MVO team leader should remain available to coordinate the implementation of the MVO recommendations and to meet with the architect/designer, the user, client, and the program manager to review the MVO recommendations, so savings may be implemented as soon as is practicable.

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Team Make Up

The MVO team is made up of experts in all the disciplines needed to conduct the study and cover all the areas of major focus. For example, if the subject review was a building we would need expertise from

- Architectural
- Structural
- Civil
- Mechanical
- Electrical
- Cost/scheduling engineer
- Value specialist team facilitator

Representatives from the client staff such as maintenance and operations (M&O) can bring light to many issues related to the future maintenance and improvement of the existing structures.

Each member of the team would become familiar with the information in the beginning of the study. Each team member would create new ideas for their respective areas during creativity phases. Their expertise is needed during the evaluation phase to refine the list of ideas to best few workable solutions. During the development phase their depth and experience is needed to develop a thorough and well thought out package. This package should sell itself.

When the report is finished and the presentation is given to the client, the

reader will receive a report that summarizes the findings and improvement in certain areas. These finding should stand on their own and be supported with documentation to convince the reader and implementation managers to strongly consider these improvements.

It is an advantage if the team is mostly made up of those who have previous study experience.

12

A Sample "Live" MVO Study

MANAGING VALUE OBJECTIVES

The value methodology (VM) can provide the steps to accomplish intended functions for less cost while satisfying customer requirements. Performing MVO on a project takes time and commitment, but it can provide recommendations that improve the overall expectations for the project. A selected team will apply the step-by-step job plan to a live MVO study.

In this chapter the reader will become acquainted with MVO, and what it can do to improve management challenges. With MVO the project team can assure that what is budgeted will accomplish the intended functions. For companies that want to do something to improve their expectations for the project, MVO is a tool that can improve the outcome and make everyone feel better about the decisions they are about to begin to implement.

There is a good message with "managing value objectives," and it is our intent to convince others of the advantage of using this process. Managers that have used MVO have developed criteria that meet customer expectations, improved team performance, and produced on-time projects within budget with fewer complications.

Introduction

Many projects are challenged with finding the appropriate method that works to improve results. It is intended by writing this material to demonstrate that there is

a methodology that exists in today's marketplace that can improve the outcome of each project. This methodology, known as MVO, is recommended by SAVE International. MVO will be applied to a hypothetical computer company problem that is similar to problems other companies may be facing. This chapter introduces the reader to the general applications of the multistep job plan and clearly indicates its application to the hypothetical example. The multistep job plan used here consists of:

- Information gathering
- Creative
- Evaluation
- Development
- Presentation/reporting

Each of the steps is used in this case for managing value objectives and improving the outcome of projects.

Managing objectives is difficult enough without adding a third dimension. This third dimension is value. Not only is each project faced with defining the customer requirements and building the product or project according to those requirements, but also the manager is confronted with day-to-day problems that must be overcome. One way to solve these problems is to use a tool such as MVO. There are other tools being used to solve these management problems, but the writer believes this MVO tool can provide a break through to solve almost any item on the manager's plate on a daily basis. It can also be used to determine the course of action to take on a program from the beginning, or it can help determine the actions to take in the midst of crisis. Its use at any phase of the project can provide the team with extra well thought out solutions that work.

MANAGING VALUE OBJECTIVES

Section 1

Identification of the Scope

Why does the manager need to identify the scope? When the manager has a group working on the project, they each should know what is expected and what can be done about it. When the team is asked to participate in improving the project, they say, of course, to include them. Because they want to be a part of making a better project/product.

When they are asked by the client to design a new product, they take it on as a challenge. However, when they are asked to find a way to bring the project in on time and within budget, they cringe at thinking of all the time and effort it will take this task team to unravel the associated problems.

Let us look at a hypothetical case. For example, a computer company is trying to determine which method they should use in understanding, critiquing, reformatting, sequencing, reporting and implementing solutions for their major computer repair problems. The methodology that will be discussed and used during the writing of this paper is called MVO. The group involved in a project like this has several things to accomplish. However, in this case it is simple (as determined by the CEO), the team needs to reduce the amount of returned computers and find a way to increase profitability.

Many reasons exist that cause management to do things that cost too much money. Just a few of the many reasons are (1) not enough time, (2) habits and attitudes, (3) customs, (4) need to meet standards, (5) lack of knowledge, (6) lack of training, (7) lack of management support, (8) too many conflicts at the same time, and (9) erroneous cost, schedule and performance information to make informed judgments.

Let's assume that a vice president of the Hypothetical Computer Company (HCC) had a long meeting with his staff and determined that their problem consisted of:

1. Too much wasted time to produce the product
2. Too many orders are returned because of errors
3. Too many products are shipped incomplete or not on time

Many companies use various problem-solving tools to solve problems and develop better solutions. MVO is a new dimension problem-solving tool that HCC has decided to try to improve the three areas shown above. The team followed the MVO multistep Job Plan recommended by the SAVE International organization. The job plan consists of the five steps: (1) information gathering, (2) creative, (3) evaluation, (4) development, and (5) presentation/reporting. After completion of the five steps the MVO team may remain involved to implement the best recommendations.

The team met on the first day of the five-day MVO study in a conference facility comfortable for 20 professionals conducting this type of work. The facility was off site so that the group could work together uninterrupted for the duration. The conference facility was complete with the amenities they needed to work together from 8 a.m. until 8 p.m. daily. If anything were needed during the MVO study the company would provide it on short notice.

The team was made up of a representative from each major area of focus. Representatives from design, manufacturing, shipping, packaging, customer

representation, remanufacturing, attorney, accounting/productivity analysis, scheduling, and a skilled facilitator were included on the team.

Information Gathering

During the first phase of the workshop the team spent time gathering information and getting everyone up to speed on the key issues on which they were about to focus. The team sifted through the documents and a key company agent discussed the issues in detail. All three major issues were reviewed with the entire team in the first half-day. The team took a tour of a facility where the products were designed, manufactured, packaged, shipped, and returned. The tour also included discussions with the department managers to get a sense for the associated issues. One part of the tour informed the group of the redesign, remanufacture, and rework part of the issues. Another part of the tour focused on the customer satisfaction issues. After the team absorbed the information in written, verbal and visual formats the group was ready to summarize their findings. Solid constraints were marked which included items that the team could not change. The constraints were that the products had to be fixed in-house.

Function Analysis

Next, the team developed a function analysis of the three major areas of the study focus. The function analysis consisted of identifying the verb and noun for each major function. For example, the functions (verb, noun) of the areas are as shown below, classified as basic or secondary:

1.	Design	Define product	Basic
2.	Manufacture	Form product	Basic
3.	Package	(Safely) package product	Basic
4.	Shipping	Ship product	Basic
5.	Receiving	Receive product/parts	Basic
6.	Redesign	Repair product	Secondary
7.	Repair	Repair product, satisfy customer	Secondary
8.	Reshipment	Satisfy customer, ship product	Secondary
9.	Shop	Repair product	Secondary
10.	Accounting	Control expenditures/measure performance	Basic

During the function analysis the team diagrammed the functions so that they identified the basic, secondary and supporting functions. The purpose of the function analysis was to obtain team agreement of the issues, identify the basic function, and think of alternatives to the functions. During function analysis the team gathered additional valuable information. More than one function occurred for each major area, but only one function for each major area has been shown above, except accounting. (A FAST diagram can be drawn by the reader.)

During the function analysis phase the team performed the following:

- Analyzed function for the critical activities
- Performed function identification and analysis in the multidisciplinary team session
- Identified and defined the functions of the project or subsystem; then defined the functions of each product element using an active verb and a measurable noun
- Classified the functions of each element as basic (essential to meet the user/owner needs and requirements) or secondary (supporting functions that enhance user/owner needs and requirements)

The basic functions must be fulfilled in any alternative. The secondary functions describe features, attributes, or approaches that implement or enhance the basic functions.

The MVO team then collectively estimated the cost, and the worth, for each function. This worth is the team's estimation of the least cost (initial cost, presented in same terms as the design professional's cost estimate) required to perform the specific function. It represents a target for the team to obtain the necessary functions. The team determines the worth figures based upon their experiences on similar projects. During this function analysis the team determined the functions as they occur now which helped them diagram the functions as they thought they should be performed.

After the estimated cost and worth was shown on the table they divided the design professional's cost for each system or functional group by the basic worth, to calculate the cost-to-worth ratio. A ratio greater or less than 1:1 indicates an opportunity for cost improvement. The greater the ratio, the greater the opportunity for improvement. The MVO team concentrates on those opportunities during the next phase of the workshop, the creative phase.

A high cost-to-worth ratio (value index) indicated areas where the team concentrated to meet the needs and requirements established by the user/owner for cost, performance, and reliability of the element being studied.

Cost Models and Determination of Worth

A comparison of the cost to worth of each function clearly informed the team of potential areas of improvement. For example, the average cost to ship the product was $150 per computer product. The same computer could be shipped for $50 by other means (this method was used to calculate the worth for each function, by benchmarking to industry standards for similar situations). The cost to worth ratio would be 150/50 = 3 to 1, a potential area to focus for cost improvement.

An example of the cost to worth for each function is shown below:

Item	Function	Cost	Worth	Value index cost/worth*
Design	Define product	$1000	$500	2.0
Manufacture	Form product	$100	$100	1.0
Package	Package product	$25	$5	5.0
Shipping	Ship to customer	$15	$3	5.0
Receiving	Receive product	$25	$5	5.0
Redesign	Repair product	$150	$1	150.0
Repair	Repair product	$250	$1	250.0
Reshipment	Satisfy customer	$15	$1	15.0
Repair shop	Repair product	$50	$1	50.0
Accounting	Control expenditure	$100	$10	10.0
Total		$1830	$627	2.8

*Some practitioners use worth/cost instead of cost/worth.

Assumption: the cost to remanufacture is higher than original worth to manufacture due to off assembly line repairs by higher priced one time shop repair.

A cost model depicted the most costly items that contributed to the product life cycle cost. For example the cost to design was only worth $500 per unit versus an actual cost of $1000 per unit. The cost model informed the group of potential areas where their time should be focused for greatest chances of improvement.

Section 2

Creativity

There were barriers to thwart the team's thinking process during the creativity phase (brainstorming); any idea thought of to perform the intended function was listed on the flip chart. While brainstorming on each major function the team was kept cognizant of the constraints (items that the team could not do anything about). The team created as many new ideas as possible and this segment of the MVO job plan was not completed until everyone had exhausted their thoughts on each subject.

During the creative phase the team performed the following:

- Develop a list of ideas for possible solutions for the functions defined in the preceding phase, without regard to attributes
- Encourage each member to suspend judgment

As an experiment during this hypothetical case the team was made up of industry volunteers from the SAVE International industry segment professionals, and a University of Florida's School of Building Construction. These individuals were asked to participate in the creative phase (brainstorming) via computer e-mail. Lists of ideas were compiled from each individual and distributed for each other to think of other ideas and resubmit those during a later e-mail transmission. Each professional represented a segment from one of the categories for this hypothetical case and submitted ideas via email for consideration by the team.

The questions posed to the team via e-mail prior to the online brainstorming experiment for creating new ideas for potential solutions on this case problem are listed below.

You have been selected as a group of professionals to provide some valuable input for possible ways to resolve the HCC potential problem of failed computers.

What is needed from each of you are some creative ideas to improve the management of a company, given the following scenario. The experiment consists of obtaining brainstorming ideas via long distance e-mail communication.

The scenario is that each of you pretends that you are the vice president of a division in a computer manufacturing company. Delasol (VP of Production),

Carey (VP of Customer Relations), Randolph (VP of Shipping), Tenor (VP of Packaging), and Lenzel (VP of Design).

The problem statement is this: HCC is a worldwide manufacturer of the latest computer. Their annual sales exceed $1 billion and profit is merely 10% of the sales volume. Eighty-nine percent of the customers are satisfied, but there are too many returns requiring redesign. Production has to remanufacture, package, and reship nearly 11% of all computers made.

What you as a group need to do is brainstorm up to ten new and innovative ideas to improve the profitability of the firm. There are no constraints. So when you have thought of and compiled the ideas for your division, please send me up to 10 innovative ideas to improve the company.

Thanks for taking the time to participate in this experimental on-line e-mail brainstorming session. Although the scenario is experimental, I will be able to begin preparing the Value Analysis report based on your ideas.

Ideas received from the customer perspective is as shown below (ideas were received via e-mail):

1. Check the database and analyze the product returns information for the past year. Look for any consistency in product or manufacturing defects that can be corrected internally.
2. Consider launching a "commitment to quality" campaign, involving personnel from packing/shipping, assembly lines, design engineering, programming, executive, etc. In other words, get employees involved from all levels and departments in participating in quality management. Reward viable suggestions, create quality contests, performance awards, etc. Allow all employees to have "ownership" in quality results.
3. Examine the packaging and shipping methods to be sure the products are adequately protected and handled during shipping. Implement changes to improve level of protection/packing.
4. Conduct a survey of a random sampling of customers to measure the level of satisfaction with the company's product. Analyze the results and act accordingly. Perhaps there are even more dissatisfied customers who didn't actually have to return their product.
5. Examine the telephone technical support staff and procedures. Be sure staff is adequately trained to handle technical problems over the telephone to prevent as much return as possible. Make sure customers are treated with respect, not kept on hold for "eons," etc. This is an important area and can make or break the relationship with the customer. Perhaps communication skills training would be needed.
6. Establish an Internet based diagnostics program where customers can actually link up to technical support and our technician could "see" and "talk to" their computer to help solve problems.

Other ideas received were:

1. If the company has a modest profit, they may be able to absorb the 11% of unsatisfied customers.
2. Could the company provide free shipping for the returned items? (1) That may assure some of the quality of our products. If the intention is to cut cost, nothing comes to mind except work on the Q/A program and identify if any value analysis is warranted.
3. Lessons learned may be an option.
4. Determine why customers returned the product.
5. Do a customer survey and try to answer this question.
6. The reason for the unsatisfied customer is in the end product and may be the customer could be improved.
7. Could the company provide free software as well as hardware support?

Having just bought a new computer, one person found that the most important aspect of his computer manufacturer is their customer service, and how he was treated when he called them with a question. How long he has to wait for a live person, and how competent and cooperative the person is that is taking care of the problem is of importance.

It is amazing to see the group of people that have started buying new computers. For most it is their first computer and they need to be able to set up their PC for the basic functions like Internet and e-mail.

Additional ideas received were:

1. Design (1) check design development to see if there are any problems; (2) check parts that were causing problems and see if they cannot be ordered from outside source(s) for installation in-house; (3) are parts causing the problems compatible with your competitors' parts? If so, order from source(s)where your competitors obtain these parts.
2. Manufacturing (1) determine from the batch numbers of returns where and when these return computers were manufactured; (2) determine if overtime was involved in any of the returns; (3) how was quality control conducted and by whom, especially inspection part of the quality control procedure?
3. Packing (1) check by batch numbers of returns to determine when boxes were packed were overtimes involved? What was done different from those that were not returned? (2) Determine from batch numbers how returned computers were packed.
4 Shipping (1) was shipping company(ies) for returns different from non-returns? (2) What time of day were the returns shipped?

Brainstorming ideas received from another team member were:

1. The costs used in the cost/worth exercise needs to be validated. The cost to remanufacture is almost double manufacture. At that rate send new ones.
2. Suggest an in depth VE study of the design using as much in-house people with a balanced input from those out of the company. The basic problem appears to be a lousy design.
3. Consider setting up an independent repair shop and include incentives for quick, effective repairs.
4. Initiate an employee suggestion program to improve design, quality and durability. Use significant rewards to encourage participation and establish an effective review board with deadlines and decision-making powers.
5. Consider manufacture of product overseas to enhance profits.
6. Augment the QA/QC programs. The existing programs (if any) do not appear very effective.
7. Augment the employee training programs relative to production controls and zero defects.
8. Set up an immediate random testing program of items at truck loading. Use program to try and identify the weak links in the total delivery process.
9. Set up a new program that will allow customers to get immediate action on returnable units. Consider shipping a new unit as they ship the old back. Then you can take time for repairs with a less angry customer.
11. Consider setting up a mobile "swat" team to assist customer's repairs and to identify quickly production/delivery problems.

People Skills Techniques Used During the MVO Study

It is important to keep the team energized and make sure everyone understands the scope of the problem. During the creative phase it is important to get ideas from everyone on the team. The goal is to derive quantity and not quality of ideas during brainstorming. Idea generation should continue for as long as the ideas are flowing and should not stop until everyone is exhausted (about 2–3 hours). In this case though we have added another experimental technique by brainstorming via e-mail.

It is important to get a volunteer to document the findings of the study during the MVO session. Everyone is involved throughout the whole session and well-written developments are a key to selling management on each idea's merit. People skills are important to any venture, particularly during the MVO process because the team's work occurs during a shortened timeframe (usually a week) as compared to the normal duration of the design process.

Section 3

Evaluation Techniques

The team was advised on various methods for evaluating the ideas to determine the best ones that should be considered for further development. One evaluation method was to list advantages and disadvantages for each remaining idea, and determine as a group a score the ideas would have when compared to the original method or to another high-ranking idea. Options for producing parts may be discussed for reducing the shortage of parts needed during production in order to produce a quality product shipped without error to reduce the number of returned products.

List the criteria for evaluation that were established during the preparation effort. List each alternative's advantages and disadvantages. Using any generally accepted ranking procedure, rank each idea on both how well it meets the criteria and on how well it performs the required functions. Do this evaluation as a team. If none of the alternatives performs every criterion satisfactorily, return to the creative phase using the knowledge gained in evaluation and create new alternatives.

An evaluation matrix works well when comparing competing alternatives. The team leader may want to devise a matrix that includes all the important components to be considered during the comparison of the alternatives. For example, the important features to include on the chart would be ease of maintenance, standard design, error free components, size of package/shipment, and reduction in hours to monitor production performance. When each competing alternative is ranked on this matrix, the team has a tool to possibly discard an idea so that the team can develop the best ones to improve the products.

During the evaluation phase the team selected the most beneficial ideas to be developed further during the development phase. Out of 100 ideas (all ideas are not included yet) submitted by the team during the course of this study, the team used the most significant ones that met the criteria of improving time, performance, cost to fix the computer, and returns for customer satisfaction.

The new ideas were grouped into four major areas that indicated a value mismatch from the value index. Those four areas were (1) design, (2) production, (3) shipping, and (4) accounting.

1. Design: Define product

    - Specifications updated quarterly
    - Design of parts per new standards
    - Parts suppliers in lieu of making own parts
    - Use computer aided design

2. Production: Form Products

- Consider setting up an independent repair shop and include incentives for quick, effective repairs.
- Initiate an employee suggestion program to improve design, quality and durability. Use significant rewards to encourage participation and establish an effective review board with deadlines and decision-making powers.
- Consider manufacture of product overseas to enhance profits.
- Augment the QA/QC programs. The existing programs (if any) do not appear very effective.
- Augment the employee training programs relative to production controls and zero defects.
- Set up an immediate random testing program of items at truck loading. Use program to try and identify the weak links in the total delivery process.
- Set up a new program that will allow customers to get immediate action on returnable units. Consider shipping a new unit as they ship the old one back. Then you can take time for repairs with a less angry customer.

3. Shipping: Ship product

- Review contracts with shippers
- Consider bulk discounts with the shippers
- Choose alternate shippers to largest supply areas
- Use direct shipping
- Consider outsourcing the shipping
- Create smaller hub distribution/shipping centers

4. Accounting: Control expenditure

- Streamline operations
- Develop new procedures for billing/receiving
- Follow up with customer complaints
- Review methods for financing
- Consider new techniques being used by competitors to attract new customers

Ideas shown here will be supplemented with ideas received from e-mail brainstorming session from others.

The writer has e-mailed each VP the list of brainstorming ideas that each are to rank in their opinion is better than the way the HCC is now performing the work in each leading category.

After the evaluation phase the team developed selected ideas further during the next phase. Most of the study time during the one-week period is spent during the development phase. The evaluation matrix used by the team during this experiment is shown in the table.

Evaluation table used by team Weight 1–9 9 = high Rank 1–5 5 = high	Repair time	Performance	Repair cost	Disruption	Modification	Accounting	Total	Rank
Weight	9	8	7	8	8	5		
Rank								
Original design (repair in house)	4 36	3 24	3 21	3 24	3 24	2 10	139	
Customer satisfaction	4 36	4 32	2 14	3 24	3 24	3 15	145	
CS1 Set up database to determine trends of repairs types	5 45	5 40	4 28	2 16	1 8	2 10	147	
CS2 Commitment to quality program	5 45	5 40	5 35	5 40	2 16	3 15	176	2
CS3 Protection during shipping	3 27	3 24	3 21	2 16	4 32	3 15	135	
CS6 Internet customer based diagnostics program	4 36	4 32	5 35	4 32	3 24	3 15	174	3
Design								
D1 Recheck design development	3 27	4 32	3 21	1 8	2 16	3 15	119	
D2 Check parts causing the problems	4 36	4 32	4 28	4 32	5 40	3 15	151	4
Manufacturing								
M1 Note batch numbers to determine cause	3 27	4 32	4 28	4 32	5 40	3 15	142	
Production								
Pr3 Independent repair shop with incentives	5 45	4 32	5 35	5 40	5 40	4 20	212	1

The evaluation matrix may be used for each major category to determine which ideas are better than the current method and should be developed by the team in the next phase. Those ideas ranking higher than the original design were developed.

Section 4

Development Phase

Beginning with the highest ranked ideas, the team prepared alternatives for change. They determined the feasibility of each alternative, appropriate to the stage of project development.

The team also did the following:

- Developed variations to specific alternatives that have multiple approaches.
- Estimated the costs of the best alternatives.
- Provided as much technical information on the alternatives as practical in the MVO workshop, so the design professional at the conclusion of the workshop can make an initial assessment concerning their technical feasibility and applicability to the design.

They supported each alternative with:

1. Written descriptions of the original concept and the proposed alternative.
2. Sketches of original design and proposed alternative.
3. Technical backup, including but not limited to calculations, catalogue cuts, and vendor information.
4. Advantages and disadvantages of the alternative.
5. Discussion of the alternative to clearly communicate the idea to the reviewer, including information about implementation, for example, cost, schedule, and potential conflicts.
6. Cost information, including initial and life cycle cost estimates, as appropriate, which clearly displays the differences between the original design costs and the alternative's costs.

Developing alternatives is where the team may want to utilize each other's expertise to develop the best alternatives for further consideration and implementation for continued improvement. The development of an idea contrasts the MVO team's alternative with the original design. The development format should include a sketch of the MVO team proposal and the original team design concept. Each idea developed would include a calculated life cycle cost estimate comparing the original to the proposed to clearly show the advantage of considering the alternate. A written justification should be clearly written to convince the reviewer that the alternative should be considered.

These ideas often sell themselves and are convincing to the reviewer. There are times when it appears like an idea should have been thought of before now. A listing of bulleted points indicating advantages and disadvantages for each idea should be included. This listing should be complete to inform the reader of the consequences of considering further implementation. Some ideas cannot be fully developed during the weeklong workshop. As necessary the team writer should include steps to be taken by the implementers in order to complete the task and fully test the ideas. On occasion the team finds that one or two ideas may not be feasible. Once it is determined that a particular idea is not workable the team drops the idea immediately and proceeds with the next most advantageous idea. It is important that potential cost/time/performance savings be on a similar basis as the original method. The life cycle cost savings should be completed and compared for each alternative. If necessary, the exercise should be brought back to present day dollars for equal comparison. The team is advised that each item should not be inflated to possibly portray more savings than could be realized.

Once development has been completed, each team member would exchange each development with one another so that the written material may be reviewed from other perspectives. Any missing information from each package should be completed and resolved before presenting the idea to management for consideration.

MVO products are produced with a team effort and the MVO study follows a team approach. Many facets of a real project occur in the MVO team workshop just as they do on a long-term project. But since the work is being done in such a short time frame and under pressure, the team must be on their best behavior.

People skill techniques are important for every study. Since MVO causes change, the team is working under pressure to convince other parties that change is for the good. In conducting the study it is important that the team does not get lost in the details and pays attention to keep the end objective in mind. When the team develops the ideas, it is difficult to be a writer and critique the information at the same time. In the end, the report needs to convey to the reader that improved options are available for consideration.

An example of the development format to be used by the team during this phase is as shown:

Development format

STUDY computer repairs

Original concept	
Computers are returned for repairs (11% of all computers sold are returned).	
Proposed change	
The MVO team recommends that the returned computer owners be shipped replacements immediately.	
The returned computers should be shipped to a remanufacture for less costly repairs.	
Advantages	**Disadvantages**
Less cost	Redesign remanufacture process
More profit	
Less time consuming	
More satisfied customers	
Summary of cost savings	
Original cost to repair:	$2,500 per computer
Team recommendation to repair:	$200 per computer
Total potential cost savings:	$2,300 per computer

Section 5

Presentation to Management

Communication is essential to the success of an MVO effort. Therefore, the team conducted a meeting on the last day of the MVO workshop. They presented each of their alternatives to the MVO study interest group to explain the intent of each alternative before any implementation actions begin.

The team prepared a written report of their findings that was submitted to the deciding parties shortly after the presentation. At a minimum, the team should present the alternatives with supporting documentation and potential cost savings. They established a specific date for submittal of the report so implementation could begin without delay.

When presenting the findings of the team to the panel responsible for reviewing suggestions, it becomes important to make the presentation clear, concise, and short.

It is important to prepare sufficient materials on the best ideas before making a presentation. This type of communication medium may take different shapes depending on the point being made, the audience, the surroundings, the sophistication needed, and the expectation of the receivers. The sponsor has paid for the team to study the subject all week so they should have a worthwhile presentation at the conclusion.

Presentation of the ideas should not be taken lightly. The MVO team should realize that they have influence on the outcome of the project. They can make a difference in the way the product will be produced after the conclusion of the MVO study. What does management want to hear? The team should put themselves in their shoes.

Section 6

Implementation Techniques

Ensure that implementation will occur by developing an implementation plan and schedule, assigning responsibility for implementation activities to a specific individual, and establishing a monitoring system. The implementation method varies on every project. The HCC Company determines this responsibility and assigns it to the professionals on the team.

The professionals and HCC review the proposed alternatives independently and determine the applicability of each alternative. The professional and HCC meet to decide the final disposition of each alternative. HCC directs the professionals to implement those alternatives that best meet HCC's needs and requirements. Also the company may direct the MVO professionals to perform further

analyses to determine the feasibility of implementing specific alternatives that appear to meet the needs and requirements of HCC but do not provide enough detail to verify implementation.

The MVO professional documents the reasons why specific alternatives have not been implemented. Some examples are as follows: the acceptance of one alternative will preclude the acceptance of another; or after further analysis, the MVO professional learns that an alternative is not technically feasible; or of several options presented that are comparable in cost, performance or aesthetics, one is simply more suitable.

Section 7

Conclusion

In conclusion, MVO is an important part of competing in today's marketplace. The MVO process takes shape by following the SAVE International recommended 5-step job plan, consisting of Information, Creative, Evaluation, Development, and Presentation/Reporting.

As a result of the participation from the group consulted to obtain new creative ideas the MVO team was able to solve the HCC problem of too many returned computers. Their analysis using the MVO methodology clearly indicated to management that the MVO team developed a viable solution to resolve the apparent problem. Through their efforts the HCC Company was able to regain their market share and regain customer satisfaction. As shown to management the MVO team saved the HCC over $2,000 on each returned computer repair.

The main benefit from conducting such a study on a program/project/product is that the manager of a value improvement program has a valuable tool, with MVO, to manage the value objectives for which he has control and is expected to produce. The managers' goals are to produce the best product, with the least of amount of errors in the time frame allowed and within or under budget according to the customer's expectations. MVO is one effective tool to help the manager meet and exceed the project goals. Side benefits from conducting the study are numerous including better team relations and more informed group dynamics.

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MVO Study Examples

Completed Study Formats from Value Improvement Studies

Project Map

Value Improvement Study Summary

Study Number: ICS 1001

Study Location: South Florida

Study Title: Industrial Scale Company

Project/Process/System/Technique Stage: Planning

VALUE STUDY

INCORPORATED SCALE COMPANY

PREPARED FOR:
State Bank

PREPARED BY:
Value Consulting

DRAFT

Date of Workshop:

Date Submitted:

Submitted by: CVS Team Leader

VALUE IMPROVEMENT STUDY

TABLE OF CONTENTS

EXECUTIVE SUMMARY REPORT

INCORPORATED SCALE COMPANY

INTRODUCTION

The State Bank contracted with Value Consulting to determine the best value for the expansion plans at its southern location.

SCOPE

The Value Analysis study focused on the analyzing the preliminary planning documents. The team selected for this study was from the Incorporated Scale Company, the designer, contractor, and the operations and maintenance staff.

PURPOSE

The purpose of the study was to evaluate the current location and determine if the plant should be expanded or if the alternative locations chosen to review were cost beneficial.

FINDINGS

The value study team determined that by using the value methodology that the basic function of the plant expansion to produce Incorporated grade scales to meet the recently changed market conditions.

CONCLUSION

The team concluded that the following options should be considered further as the development continues.

Item	Description	Life Cycle $ Savings	Status
1	Move Scale X to East Plant	$3,189,000/yr	Accepted
2	Scale Y in South Plant to be Resized	$12,034,000/yr	Accepted

VALUE IMPROVEMENT STUDY

ABBREVIATED AGENDA USED DURING STUDY

DAY	DESCRIPTION
One	Project Overview
	Site Visit
	Designer Orientation
	Cost Model
	Function Analysis
Two	Creative & Evaluation
	Begin Development
Three	Continue Development
Four	Finish Development
	Life Cycle Cost
Five	Presentation/Report

LISTING OF VE STUDY TEAM MEMBERS

Name	Title	Phone/E-mail
Ron Stistler	Plant Manager	
Jan Filedler	State Bank Acct Mgr	
Sue Xandler	Design Group Mgr	
Fred Wintiur	Contractor Systems	
Ralph Boiumler	Operator	
Janice Primeteir	Maintenance	
Sam Sneidfi	Financial Planning	
Dave Caniastie	Vice President Plants	

BRIEF PROJECT SUMMARY

Plants X and Y are being reviewed for potential funding for expansion and new locations opportunities to match the demand for scales in this region. The cost to renovate the existing plant is $122,045,000. The cost to locate to the new city location is $350,000,000.

VALUE WORKSHOP

PRE-STUDY ACTIVITIES

- **Select Project**
- **Determine Type**
- **Select Team**
- **Develop VE Package**
- **Identify Major Components**

VALUE WORKSHOP

PHASE ONE: INVESTIGATION (INFORMATION GATHERING) PHASE

- **Secure all the Facts**
- **Determine Constraints**
- **Develop Cost Model**
- **List Project Components**
- **Identify Basic Functions**
- **Determine Secondary and Supporting Functions**
- **Determine Worth**

HISTORY

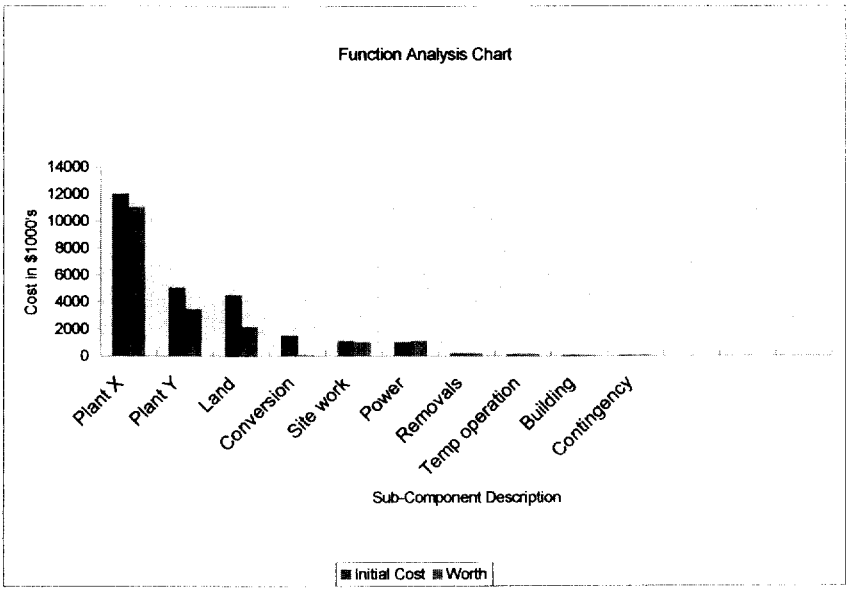
- **The existing plant has three buildings and 1,100,000 square feet**
- **The new plant is to be located on 890 acres near south Florida**
- **The maintenance cost for the 13 lines of operations is $1,023/scale produced**
- **The operations cost for the southeast operations is 1.3 times the average of the other regional plants**
- **A new market is being developed to be located in this region**
- **The anticipated life span of the new scale division is 5 years**

RESEARCH SOURCES

Item	Source
Preliminary plans	Design group
Financial plans and reports	State bank
Construction techniques	Contractor systems
Operation and maintenance historical data	Plant X

COST/FUNCTION MODEL

ITEM	PRESENT COST	WORTH	Function Verb	Noun	$=1000s
Plant X	12000	11000	Sell	Scale X	
Plant Y	5000	3400	Make	Scale Y for plant X1	
Land	4500	2100	Loczte	Plant	
Conversion	1500	100	Fix	Assembly line	
Site work	1100	1000	Build	Plant	
Power	1000	1100	Optimize	Operation	
Removals	201	200	Accommodate	Scale operation	
Temp operation	145	144	Continue	Operations	
Building	82	60	Protect	Operation	
Contingency	58	50	Accommodate	Unforeseen conditions	



VE WORKSHOP

FUNCTION ANALYSIS

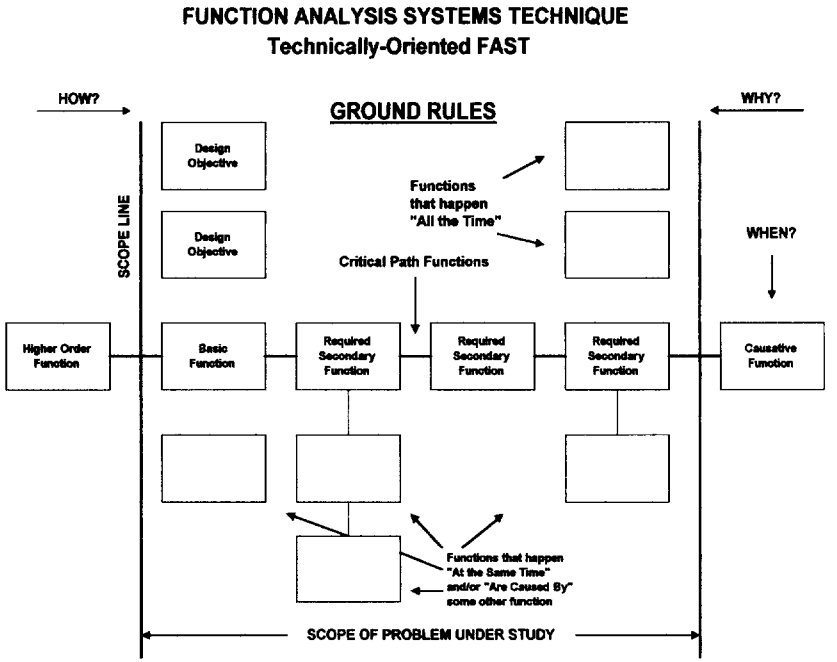
- **Assign Costs to Function**
- **Diagramming FAST**
- **Function Cost to Worth**
- **Set Goals**
- **Analyze Functions**
- **Combine Functions**
- **Improve Needed Functions**

FUNCTION ANALYSIS TABLE

Item	Description	Function	Cost	Worth	Value Index
		Verb/noun			C/W = VI
Scale		Weigh products	$12,000	$10,000	1.2
Conveyor					

Due to the proprietary nature of the scales under study all the items are not shown.

FAST DIAGRAM



Due to the proprietary nature of the item under study the FAST diagram components are not shown. Refer to Chapter 7.

VALUE WORKSHOP

PHASE TWO:

CREATIVE/SPECULATION

- **Brainstorming**
- **Positive Thinking**
- **Can Similar, Simpler Methods Be Used?**
- **Move or Compress**
- **Eliminate**
- **Modify**
- **Avoid Criticizing Ideas**

All members submit ideas.

IDEA LISTING BY FUNCTION

Item Number	Description	Advantages	Disadvantages	Ranking
1	Reduce the size of the scale room	Less cost	Space is too tight	Low priority
2	Mount end assembly on top of the drive	Reduces maintenance	Redesign	Carry forward
3	Other items were given by the team during the study			
4				
5				

VALUE WORKSHOP

PHASE THREE: EVALUATION

- **Rank the Ideas**
- **Discuss the Advantages**
- **Strive for Group Consensus**
- **Obtain User Input**
- **Get Owner Feedback**
- **Compare New Idea to Original**

EVALUATION MATRIX

Refer to chapter 12 for evaluation matrix

Item	F	G	K	L	$	T	C		
weight	3	5	6	7	4	7	6	Total	Rank
1	1/3	2/10	1/6	2/14	3/12	1/7	2/12	61	2
2	2/5	1/5	1/6	2/14	3/12	2/14	1/6	62	1
3									
4									
5									
6									

F=Financing options; G=Government specification ; K=Cost to repair; L=Life cycle cost; $=Initial cost to implement; T=Time study ; C=Constructibility.

VALUE WORKSHOP

PHASE FOUR: DEVELOPMENT

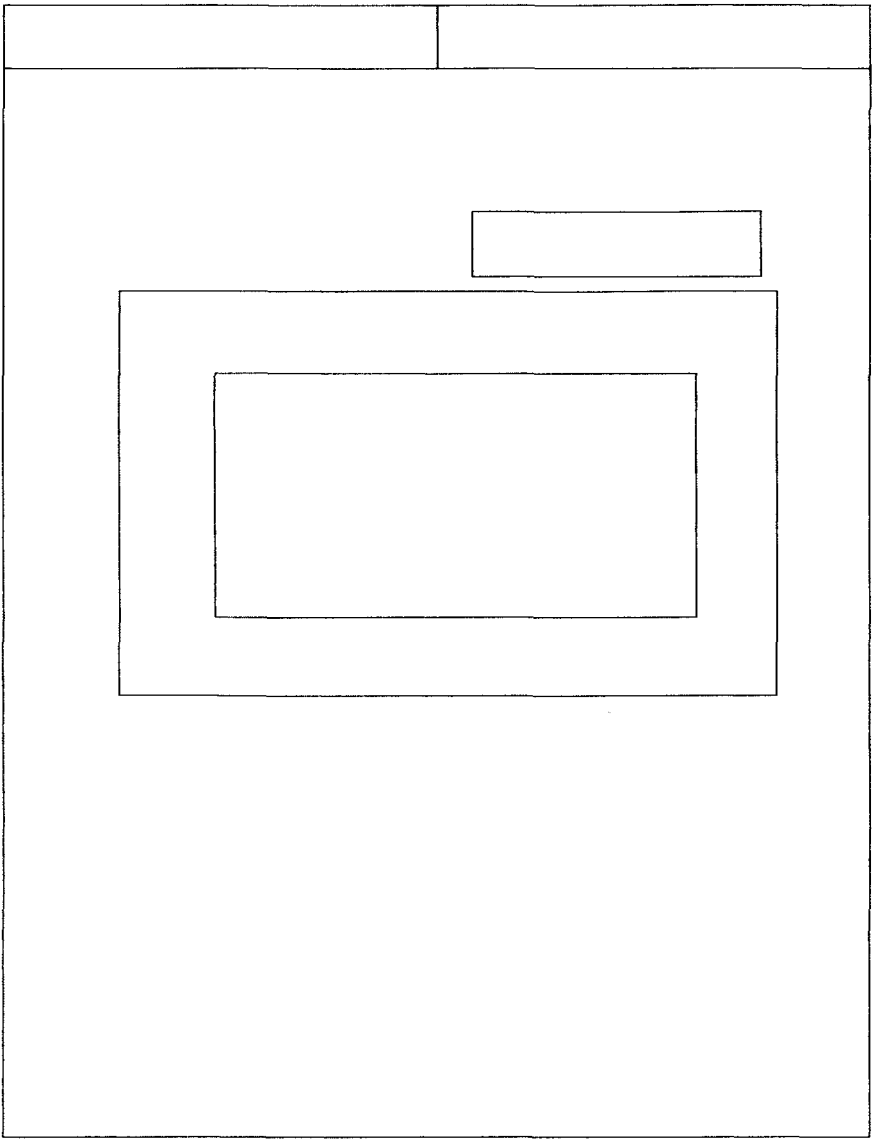
- **Will it Work?**
- **Is It Implementable?**
- **Exercise Good Human Behavior**
- **Carefully Scrutinize Ideas**
- **Ask the Experts**
- **Similar Ideas Combined**
- **Prepare to Explain the Ideas**
- **Compare Original to Proposed**
- **Advantages vs. Disadvantages**

Set the stage for further development.

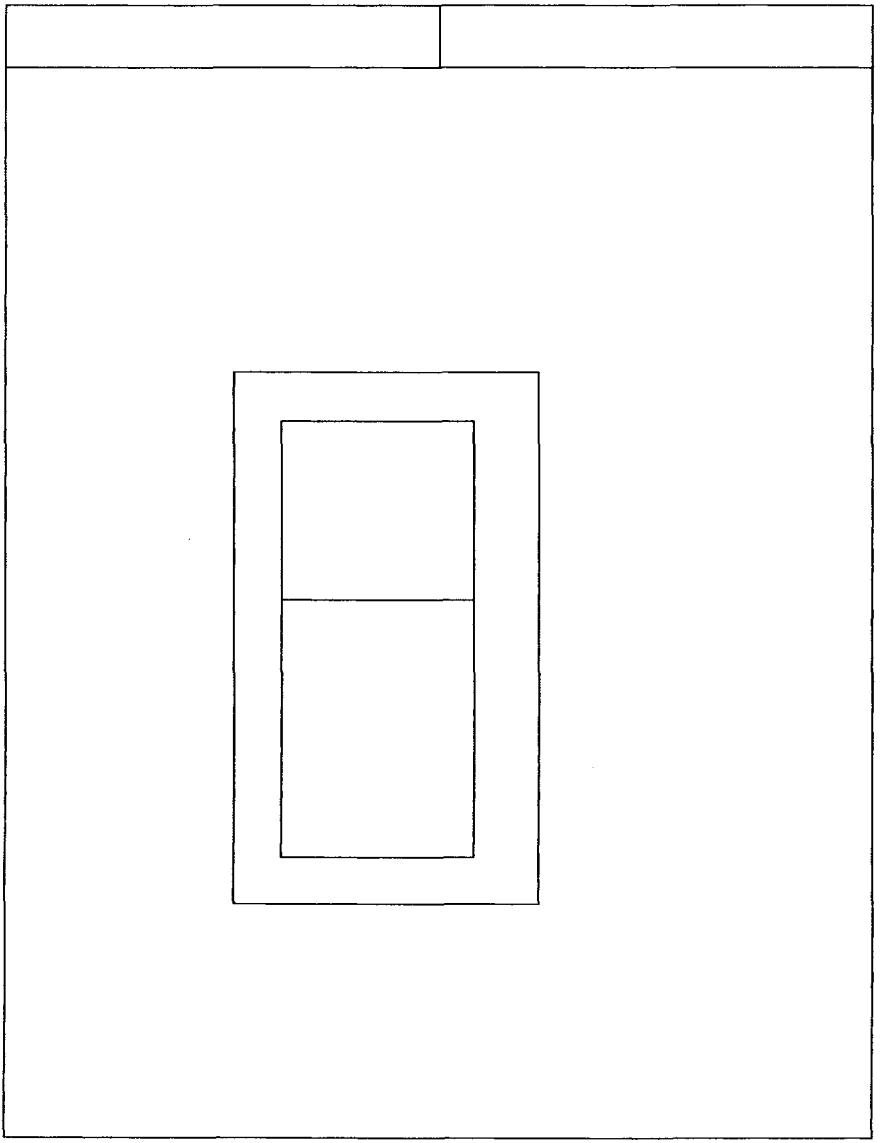
DEVELOPMENT FORMAT WORKSHEETS

Idea: Locate scale mechanism above normal position			
Description			
Normal scale is positioned in the X position			
Original			
Scale X is located in X position and scale Y is located in R position			
Proposed			
Consider locating both in the same position (see sketch)			
This would apply to scales X and Y in either plant location			
Advantages			
Reduced cost			
Reduced maintenance			
Disadvantages			
Redesign time 2 months			
Justification			
This position applies less stress in mechanism P.			
Reduces maintenance cost by 50 percent.			
Cost Savings	**Initial**	**Life Cycle**	**Total**
Original	$45,000	$500,000	$545,000
Proposed	$55,000	$223,000	$278,000
Potential Cost Savings	$11,000	$277,000	$267,000

ORIGINAL DESIGN SKETCH



PROPOSED DESIGN SKETCH



QUANTITY CALCULATIONS

Weight of mechanism is reduced by 22% (see calculations).	

DESIGN CALCULATIONS

Center, outside, right, and left sides were resized per the sketch.	

RECAPITULATION

In order to manufacture the parts the plant will reuse scrap from and make the new items to simulate the mechanism as it will be placed after installation and assembly.	

COST ASSUMPTIONS AND EXCLUSIONS

For this operation the cost for the new products are established using the Product X manufacturing and design handbook.	

COST ESTIMATE COMPARISONS

Item	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Original Cost**	**Proposed Cost**	**Potential Cost Savings**
1	Item X	21	Ea	20	420		
2	Items Y, Z	2	Ea	100		200	
							220

LIFE CYCLE COST CALCULATIONS

Initial Costs	Calculations	Original	Alternate One	Alternate Two
Life of Project	25 years			
Discount Rate	4%			
Escalation Rate	3%			
Initial Cost		$282,000	$111,000	
Annual Operating and Maintenance Costs		$45,000	$25,000	
Operating		$23,000	$12,000	
Maintenance		$100,000	$50,000	
Salvage/ Replacement Costs		$50,000	$25,000	
Total Initial Cost Savings		$500,000	$223,000	$450,000*
Total Present Worth		$4,013,000	$2,043,000	
Present Worth Life Cycle Savings			$1,970,000	

*Discarded option 2.

VE WORKSHOP

PHASE FIVE: RECOMMENDATION PRESENTATION/REPORT

- **Format Presentation**
- **Resolve Issues**
- **Motivate and Convince**
- **Overcome Roadblocks**
- **Sell Ideas**
- **Explain Benefits**
- **Show Cost Savings**

Prepare an implementable plan.

NOTES FROM THE PRESENTATION

Maintenance agreed that a simulation item would be made from the revised design. After the simulation is fully tested the items can go into production.

VE WORKSHOP

IMPLEMENTATION

- **Follow Up with Action Plan**
- **Assist to Drive Ideas**
- **Audit the Results**
- **Incorporate Improvements in Future Studies**
- **Scrutinize Designer Responses**
- **Continue to Sell Ideas**

Don't change function, but reduce cost and improve quality.

IMPLEMENTATION PLAN

Segment X will be revised
Plans are to be revised 2 months from study date
Contracts will be updated
Plans to production within 6 months from study date
Final bids are due within 9 months from study date
Financing available within 10 months from study date
Action Items
Production responsible for sequence of events until the bids are received and the operations group will complete project complete with testing
Responsibility
Production and Operations

Financial Analysis

Incorporated Scale Company

The following financial analysis report was prepared for the Incorporated Scale Company in preparation for the analysis of the operation expanding.

Financial Analysis Report

for

Incorporated Scale Company

prepared by

Value Consulting

Table of Contents

INCORPORATED SCALE COMPANY BACKGROUND

The Incorporated Scale Company began its business in 1955 by serving a market niche no other company had before served. Local teams provide unmatched services to an industry needing accurate computation of scale results.

ISC's mission statement has been to provide the manufacturing environment with Incorporated scale and associated equipment and maintenance for the industry-requiring automatic weighing, bagging, and proportioning equipment. Since its mission statement was last published ISC has began modifying it for the new millennium. Since expansions and growth are predicted ISC shall need to accommodate the future volume anticipated with the updating of its current plants, operations, personnel training, and new state of the art electronic control products.

USES OF INCORPORATED SCALE COMPANY PRODUCTS

ICS's highly sensitive automatic weighing, bagging, and proportioning equipment products are being used everyday by producers in the manufacturing, environmental, pharmaceutical, refinery, agriculture, and food processing/health care facilities throughout the nation. Typical uses include the proportioning of chemicals, and batches of material for brick making. Most of the scales produced by ICS are designed, manufactured, and operating with astounding accuracy for 120 clients nationwide. The accuracy of the scales varies, but is known to be accurate to within one-quarter to one-tenth of one percent. Since the scales are specifically designed for use in conjunction with other products in the factory environment such as bins and related material handling equipment these scales are coordinated with other manufacturers and normally sell in the range of $25 to $150 thousand per unit.

VARIATIONS FROM OTHER RELATED COMPANIES

Related scale producers such as Fairbanks Morse and Toledo are different in that these competitors do not focus on the same market segments and specialty products that ICS produces.

PLANT LOCATIONS

ICS controls its operations at two plants located in the state of Pennsylvania.

OPERATIONS

Each plant's organization is split between management, engineers and skilled draftspersons, and production workers. These professionals are devoted to overseeing that each client receives a prompt and quality design that meets the particular needs of the customers.

PERSONNEL

The two plants have approximately 35 engineers and draftspersons handling over 25 large to small projects yearly. The production personnel make up nearly 120 highly skilled and well-equipped craftsmen that can complete a typical order in less than three weeks from the time the order is received until the parts are shipped.

COMPANY MANAGEMENT

At ICS management has developed a fine mix of personnel that is geared toward finding the right solution to complex problems faced by the customers. The team approach that is practiced by the ICS Company is unmatched since the management plans the work and works the plan according to flexible schedules required by the sales personnel. Since the implementation of the Management's approach the individual teams work in harmony and have received very few rework orders. The organization has definitely shaped itself for the upcoming trends it is seeing by product expansion and new market growth areas.

OUTLOOK FOR FUTURE GOODS

Future growth plans decisions must be made on ways to finance the planned expansions and predict the volume and markets where the expansion will pay off. While some regions of the country are experiencing a downturn in manufacturing, others are pushing forward with unprecedented Incorporated activity. While these activities are hard to predict the firm feels that it will play a major role in providing the Incorporated expansion with the scale products required. At the same time it must continue the re-equipping and expansions of the existing factories and Incorporated base of our economy.

FUTURE EXPANSIONS PLANS AND STATUS OF EXISTING PLANTS

Having the ability to accommodate the future expansion of existing plants, resupply existing installations, accommodate new markets, and develop new products that meet the needs of the ever changing conditions is a large task for the management of the ICS.

Management has taken the steps necessary to keep its work force and fixed machinery up to date with the latest in recent trends. In order to correct the outdated plant reliance on outdated office administration functions located in older administration office buildings; it recently replaced the existing structure (1950s) with the one completed 10 years ago. At the same time an investment in a new building, machinery, tools, and assembly shops to house its operations at each

location was completed in 5 years ago. Management has been considering an investment of $500 thousand to upgrade the existing, or provide a third facility to absorb the expected increase in sales. Idle capacity would absorb some increase in sales, but additional machinery will be needed if sales expand more that 30%. Added volume could also require an increase in circulation capital (current assets).

CHANGE IN FINANCIAL CONDITION

The financial condition information is broken down to give the reader comparable information on the company status and change in condition in the last five years. Current ratios for the company were calculated (calculations are escalated to common dollars), and are graphically shown on the following charts. Calculations also indicate the comparative balance sheets over the last five years.

The table's figures have been adjusted (escalated by 4% per year to be comparable dollars when comparing or deriving the proforma statements).

The financial condition has changed in the last five years with the following observations:

- While there has been a slight decline in the cost of goods sold, there has been less labor required to produce the products.
- Gross profit from sales has remaining strong
- The price of the stock has increased and should continue
- The operating and selling expenses remain fairly constant
- The company continues to build the backlog of work and funds for retirement
- Concentration on reducing payables has taken place and is reflected in the proforma for 2002 and beyond

PROFORMA FINANCIAL STATEMENTS

The proforma indicates that a strong management position will exist and continue the increase in sales, increase in healthy stock position, a decline in the payables through more aggressive tactics on collections, and a correction of the amount of lost inventory.

The next year's proforma does not reflect the increase that management predicted less than six months ago. But it is an aggressive venture to keep in pace with the projected growth patterns and plans based on previous experience. In almost all cases we see a correction-taking place to correct any fallacies that may be indicated after review of the critical business features and ratios.

FINANCIAL POSITION CHANGES

ICS remains strong and has taken action to maintain its current business. Plans are expanding for a bright future and stock prices will be strengthened by these efforts. As seen on the tables and charts ICS has corrected a downturn observed in the last two-year period. The market has increased without much additional competition so the plans are to proceed full speed ahead.

CALCULATION ON PROPOSED SAVING BY YEAR

Next year's proforma statement and comparison of balance sheets indicates that savings in current liabilities will amount to $280 thousand. A slight increase in assets will be obtained. Retained earning may decrease if the expansion of the plants is needed to attain an increase in sales. Note the cost of goods sold is anticipated to increase $500 thousand bringing Sales to $4,774 thousand. ICS plans to increase sales 30% could be achieved through a steady market research plan and adjusting its in-house expenses to produce the products at the expected demands.

DEBT REDUCTION

Plans to reduce the outstanding debt by continuing to pay off the existing building loans and paying for planned plant expansions. ICS has plans to reduce payables by $300 thousand.

RATIO ANALYSIS

- Inventory turnover could be improved—4.32 times projections, but does not meet industry averages of—3 times.
- Current assets to current liabilities and quick ratios are declining-proforma indicates an upswing.
- The days sales outstanding indicates it takes time to place the product in the customer's facility and ICS is taking steps to reduce the time.
- Sales to total assets ratio is strong.
- Debt ratio is higher than normal and 5 year strategic plans should reduce this amount.
- Times interest earned is projected to equal rates in the proforma.
- Earnings per share are maintaining a good pace.
- Profit margins appear to be declining—proforma indicates an upward swing.
- Basic earning power again indicates an upward swing.
- Return on assets is improving.
- Price earnings ratio needs improvement to reach levels attained just two years ago.

- Book value and market value for the shares are rated good
- ICS may want to sell more stock in the future.
- Same trends are noted for escalated values versus unescalated values for the figures shown in the charts.

FIVE-YEAR STRATEGIC PLAN

The ICS team has completed getting through the toughest of times for the Incorporated segment of our economy. It has grown as a result of its efforts to continue its focus on the main product to meet the customer's needs. Through the strong continued management approach and vital scrutiny of its financial means to support the business its sales force will continue to add to the backlog of work in this and related field emerging.

Increasing cost of goods sold: Steps are being taken to take advantage of reduced material costs by buying in bulk quantities, and consolidating the number of suppliers used for types of materials. These efforts should decrease material costs by about 5%.

Review of factory overhead: after a comparison of the factory overhead to the direct labor it appears there is an unbalanced proportion of overhead to direct labor to accomplish the amounts of work undertaken on a yearly basis. Efforts are underway to correct these ratios to an industry wide factor of 1/3 overhead to direct labor, i.e., direct labor = 667 and overhead = 333. These overhead corrections could benefit the product line costs and not degrade performance, quality or testing of the products. A potential cost savings of $100 thousand is being recognized in the proforma for a recent year, an additional amount will be reflected in the next year's statements.

Selling expense: this appears in line with the industry standards at 10% of sales, but as ICS records indicate it is striving to operate selling expenses at 8.2% as it did 5 years ago. Other similar companies operate at percentages in the 5-6% range.

General and administrative expense: these expenses have gradually increased and steps are being taken to hire temporary help when needed to reduce the related overhead expenses. This could save ICS in the range of $50 thousand a year.

Interest expense: this has been reduced from last year due to pay off outstanding debt. The last proforma reflects a savings of $30 thousand.

Retirement plans: interviewing other plan offerors ICS may be able to reduce plan administrative costs and increase the balance by investing in a more diversified portfolio.

ICS is determined to reduce expenses and increase sales while expanding the business. This controlled expansion is going to take a consolidated effort, partnering with vendors, and listening to customer needs.

This report was based on records provided for a value study course handout for ICS dated in the last five years. Abbreviations used were consistent with those for financial management notes.

We trust that the ICS group can implement our suggestions, and call upon us to assist when needed, as we are supportive of ICS efforts to continue to improve the nature of this business.

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Phase 1: Information Gathering Procedures

FACTS HISTORY

We need to determine the scope of the item to be studied. By understanding the scope the team can assess what the team is required to have for review. The team will identify major components needed for analysis. One would ask, what is it we are studying? What does it do? What is it supposed to do? How much does it cost now? What was the budget based on? What changes have occurred since the budget was established?

Once the costs have been determined, the team should develop a model of the costs so that they can determine the areas of potential focus. Major costs may be distributed in only 20% of the items. Functions for each major cost area are identified. Functions may be broken down into basic and secondary. Once we determine the function of each cost consumer, we can ask our team, what is the function worth? Notice we asked what the function was worth, not what the item was worth that made up the majority of the cost. Most of us agree that we want to spend most of our cost for basic functions. If a secondary item contains most of the cost it may indicate an area for improvement. The team may determine that the worth for a secondary function is half what the cost is now estimated.

The problem with most cost estimates given to a team is that they are broken down by major cost work breakdown, which may not be by function. The team needs to spend some time to reallocate the cost estimate into functions. The type of view of the projects helps focus the team on the areas where they should spend most of their time.

When we gather information for the team to review we need to identify the information needed by each team member. A determination of what party has the most up to date information is needed. How many copies are needed for the team?

Distribution of this information to the team before the study begins is beneficial. The distribution of costs may be included.

Keep in mind the information given to the team may not be the latest so additional reports by other parties may need to be reviewed. Previous studies may have been completed that would indicate to this team which areas may have already been looked at in detail.

A schedule of the deliverables and when each is due should be determined jointly between the client and the team leader. The agenda of the activities to be accomplished by the team should be drafted and approved by the team and client.

A preliminary indication of constraints should be shared with the team. What are constraints? Constraints are those items that cannot change. What items cannot change for us to have this project? What are the current requirements that cannot be changed during the course of improving this project.

Questions developed by the individual team members should be documented, and answers obtained during this phase of the study. A visit of the item under study should be scheduled to give the team a more detailed understanding of the factors affecting the functions, timing, distances, climate, other related factors, cost influences, ease of maintenance or operation, and similar projects nearby that had similar experiences that can affect our decision making. We need to determine the criteria important to the owner that affects our evaluation process and decisions made during our analysis.

TEAM FUNCTION ANALYSIS

The team for each major area determines functions. Major areas may consist of categories or detailed items. A category may be earthwork. A detailed item may be rock excavation. The function for a major area may be listed by active verb and measurable noun. The function for a door in your house between the kitchen and living room may be listed as block access, or allow access, or separate spaces.

Item	Type	Verb	Noun
Door	Basic	Block	Access
Door	Basic	Separate	Space

The type of function was determined to be basic for each function. A secondary function may have been for the door to be self-locking/opening. The team usually prepares a diagram of the functions (FAST) to depict the functions by asking why and how we do the functions, they are arranged to answer these questions (an example is shown).

MODELING COSTS

A model of the major costs usually indicate the major areas where the team should focus their time to obtain the most benefit for their time spent together to analyze the component or item under study. Keep in mind that the team may not always have a cost estimate to use for modeling the costs. Some team models may focus on energy usage or schedule durations, thereby not having costs to assign to some areas. In any case the team should develop a model of the major functions, such as most of the time is spent doing these functions or most of the energy is consumed by these functions (an example is shown).

DETERMINING TARGET WORTH

The cost of the kitchen door installed was $800. The function of the door was to separate space and allow access to the next room. The team determined the worth of the function separate space was only $160, while the allow access function was $300. How did they determine the worth of a function? The worth is the least cost to perform the same function. The self-locking secondary function feature may have cost $200 extra and was not a major factor to the homeowner in this case.

ALLOCATING COSTS TO FUNCTIONS

An important step before proceeding with analysis of the project is allocating costs to functions. When this is not provided to the team the team must take time to first validate the original cost estimate and estimate their own costs for this project so that realistic cost comparisons can be made later in the study.

A value index is calculated by dividing worth into cost. VI = C/W. This indicates areas of potential focus. If an item has a VI = 1.0 it has good value. If an item is less than or greater than 1 it has potential for value Improvement. Often this referred to as a value mismatch.

CONSTRAINTS

All items have some type of constraints. What constraints do we have when reviewing a highway? The alignment may be set and cannot be changed, for exam-

ple. A site location for a new school may be located in an area to avoid underground contamination. Listing constraints is very important in the information-gathering phase to avoid team thought in certain areas that may be an area where we cannot improve anyway due to constraints in that certain area.

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Phase 2: Creative Brainstorming

PURPOSE AND TECHNIQUES USED TO OPEN OUR MINDS TO BEING CREATIVE

One advantage the human race has over any other species is our ability to absorb, think, incubate, store, remember, reason, and invent new ideas from a correlation of understanding events that took place or may take place.

Up to this second phase our study the team has gathered many pieces of the puzzle. They began understanding the written information, received a briefing from the original design team, visited the site, understood the costs contribution to major functions, and calculated the value indices.

The multidiscipline team will create new and innovative ideas for any function. The team leader or facilitator will keep track of each idea as presented by the team on a flip chart or entered directly into the computer as the ideas are generated.

Before the team begins idea generation it is best to warm the group up to being creative. It is good at this point to exercise opening our minds, thinking with our left side of the brain, doing things the opposite, rotating items, putting an item in a different perspective, and reviewing a short video on what could have been built all may help. The author often has the team perform an exercise that allows everyone to think of solving a problem that requires of thinking of solving the problem that is out of the ordinary way of doing of things. There are many

books available with lots of ideas for getting the team to begin to create new and different ideas.

It is important to remind the team at this point that any ideas are a good idea. There are no rules, except that we cannot violate the constraints determined in the information gathering stage.

An example of a team's listing of ideas for the door example is as follows:

- Item: door
- Function: separate space
- Original item description: wooden door, with...

New ideas:

- Metal door
- Aluminum or space frame door
- No door
- Swinging door, etc.

After the team has generated ideas in each major function area, the team can reconvene to review the list to refine the ideas listed by function. Another team may have listed ideas that could assist another area of the project.

Teams generating ideas can solve problems much faster that individuals trying to solve the same problem individually.

Timing of the Process

It is best to create new ideas at the right time during teamwork. It is not good to try to generate new ideas at the end of the day for most, but for some may work fine. The optimum time is before lunch or after lunch. But it is up to the team leader/members to determine the optimum time for creativity.

Examples for Listing New Ideas Generated

Our teams generate hundreds of ideas for items under study. There are thousands of examples of ideas for various categories and functions. The author prepared a database of ideas created on over 200 studies by type of work and function.

Warm-Up Exercises

It has been proven that a large quantity of ideas produces ones that can greatly improve the item under study. It is beneficial for the team to warm up before beginning the creativity phase. Some brainstorming exercises may be used to get everyone to start thinking out of the box. The group may offer out of the ordinary ideas during the exercises but this can lead to benefit the creativity phase.

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People Skills During the MVO Study

Styles vary between individuals. It is the challenge of the CVS team leader to harness the positive nature available from each VE team member to produce effective results as a team. We need to form an effective team to drive toward the study goals. It has been proven that teams produce much greater results than individuals alone can.

Each particular VE study requires a person with a range of qualities. Words that would describe the qualities of a successful leader and team are: knowledgeable, experienced, astute, eager, trustworthy, problem-solving, outspoken, order-following, neat, well-behaved, accountable, dependable, doer, assertive, finisher, and self-starter. These people must be able to: concentrate, delegate, create, work with groups, anticipate, plan ahead, set and meet deadlines, listen carefully, insist that plans are followed, preserve resources, remain focused, do it right the first time, estimate fairly, remain optimistic and be decisive. We will discuss the styles and traits of individuals so that we can improve on team selection and performance during a VE study.

While this workshop does not intend to lecture on people skills, we will point out which styles are likely to produce the greatest results. A lot of this has to do with your people skills. If you always get great results, just listen. If you think you need some pointers, please listen and take notes. If you think it is an interesting topic and would like to share your experience, do the above and also talk.

The basic forms of communication occurring during the study are:

- Listening

- Reading
- Writing
- Speaking

We can use them all to be effective leaders and team members on a VE study.

During the study we utilize several human abilities, such as:

- Intuition
- Learning
- Creativity
- Thinking
- Understanding
- Reasoning

We are able to use these different abilities depending upon the situation or segment of the study we are involved in at the time.

VALUE IMPROVEMENT A TEAM EFFORT

Just as in a theatrical production or team sport, we apply ourselves to fill a position to produce the greatest results. As a team, we can:

- Meet opportunities
- Meet challenges
- Participate
- Prove our knowledge
- Combine thoughts
- Provide winning solutions
- Be proud

Through VE team efforts, we use the team approach to produce results never before accomplished by individuals alone. VE is usually a team effort; however, there are times during the study when we need to produce individual results. Value improvement is an area where the problem-solving tools are people. Effective team results come from following the job plan. The leader also:

- Provides staff or team
- Organizes
- Facilitates
- Controls problem-solving
- Provides tie-breaker rules

- Sets common goals/direction
- Motivates
- Provides direction
- Maintains schedule
- Utilizes high-quality work
- Manages conflict
- Avoids bias
- Remains fair and decisive
- Interacts with team
- Sees the big-picture
- Keeps an open-mind
- Handles confrontational issues
- Inspires team to commit
- Is persuasive, clear, and concise
- Reports results

In short, effective teams understand their goals to meet the quick paced, fast flowing, and demanding value study.

COMMUNICATION STYLES

As we ready ourselves for the value adventure, we take a short sideline trip to understand a few styles that can be used for effective value studies.

Listening Styles

Listening styles vary, but the most effective styles are those shown below.

1. Silence is golden
   - Keep quiet and let the other person explain the concept
2. Acknowledgement
   Presenter gets message that listener is getting the message. Nod the head "affirmatively" with an:
   - "I see"
   - "I hear you"
   - "Mm-mmm" or "Uh-huh"
3. Active Listening
   Active listening establishes a dialogue between the listener and the speaker. The speaker can tell that her/his message is understood by the

feedback from the listener. The listener gives this feedback by showing expression and asking questions.

4. Door Openers
   - Listener invites a willingness to listen
   - "What about..."
   - "Tell me more about..."
   - "What does it do?"
   - "Is it needed?"

5. Listening Tips
   - Don't jump to conclusions
   - Avoid distractions
   - Listen for what is *not* said
   - Understand concept, don't argue with speaker
   - Don't give up before you understand
   - Control anger
   - Avoid extreme emotions or prejudices
   - Concentrate
   - Ask questions

LISTENING

Typically, we spend about 40% of our communication time listening. We usually talk, read, or write less than we listen.

Listening can affect the workshop success, team relationships, team leader effectiveness, decision-making, other people's impressions of us, and our lives in general. Unfortunately, listening effectiveness is rarely emphasized in training.

LISTENING BENEFITS

The drawbacks of poor listening:

- Costs money due to lost time
- Loses ideas as a result of misinterpretation
- Can lose business
- Causes misunderstanding
- Consumes time

The Benefits of Good Listening

- Builds trust
- Shows client your sincerity to help
- Influences others
- Good listening improves response from the speaker
- Increases persuasiveness of presentation
- Helps identify client concerns
- Directs our attention to issues

TYPES OF LISTENING

Becoming an Active Listener

Each situation is different:

- Effective listener defines situation quickly.
- Decipher which information takes precedence.
- *Brainstorming event creates environment to feel free to:*
  - Think of innovative solutions
  - Make unusual suggestions
  - Defer judgments or critical evaluations of ideas

Be an attentive listener by making sure that you:

- Focus on main ideas
- Ask for clarifications
- Avoid premature judgments
- Summarize the discussion after the meeting
- Listen for main meaning
- Judge content rather than delivery
- Watch out for opinions
- Ask for evidence
- Act as a sounding board
- Pay close attention
- Write all ideas and suggestions

When all of the items outlined are used, it is referred to as "active listening."

HOW TO IMPROVE YOUR LISTENING ABILITY

Eliminating Listener Roadblocks

Here are a few things to beware of when you are listening:

- Hearing is not always listening
- Brain turn-off
- Agenda interference
- Interruptions
- Posture not aimed at speaker
- Looking away from the speaker
- Make eye contact 75 % of the time
- Body language

As listeners, we only interpret a speaker's message according to our own experience level and perspective.

To improve listening ability:

- Note the listening speed sense all expressions (we hear three to four times faster than people speak)
- Keep external interference out
- Visualize the topic
- Rethink what is being said in your own terms
- Listen for nonverbal communication
- Listen for the key meaning words that may bring it all together later

FEEDBACK FROM THE LISTENERS

Let the Speaker Know You are Giving Your Attention

- Ask open ended questions
- Ask the speaker to elaborate
- Allow for silence to encourage more about the subject
- Ask for an example
- Ask the speaker to confirm/correct your understanding of the topic

HOW TO LISTEN MORE EFFECTIVELY

Interpreting the Message

- Determine the function.
- Ask yourself, "What is it worth?"

- Ask yourself, "Why is it needed?"
- Assess the ideas presented
- Ask for clarification
- Ask for listing of advantages and disadvantages
- Note inconsistency between verbal and non-verbal messages
- Further explain conflicting message

How Can We Remember?

- Put it into long-term or short-term memory
- Take notes
- Document or summarize findings
- Follow-up with action promised
- Use mental pictures to improve memory
- Paraphrase key items

In summary a speaker should tell the audience what is to be covered, tell them in detail, and then summarize for them. Listen, take notes, and reserve in memory.

SPEAKING STYLES

Style Types

The second most often (besides listening) misused people skill is our ability to use speaking to our advantage.

There are several different speaking styles. Some styles are as follows:

- Casual
- "Get it done"
- "Let's think about it"
- Need or want?

You usually want to communicate:

- Needs
- Actions
- Thoughts
- Feelings

ACHIEVING SPEAKING CLARITY

Know why we are communicating

- To change?
- To inform?

It helps to know the audience being presented to.

Who are the listeners?

- What are their backgrounds?
- What do we want to achieve?
- What is expected from the meeting?

Additional pointers:

- Understand your influence on the audience
- Don't talk too much
- Don't assume too much
- Arrange appropriate time and place for exchange of information

A speaker adds impact by:

- Choosing correct order for information presentation
- Using convincing points
- Itemizing for clarity
- Making it easy to remember
- Speaking their language
- Restating main ideas
- Organizing, previewing, developing, reviewing, and presenting
-

ORGANIZING THE SPEECH

Preview: Start your speech with a preview showing a complete and ordered list of points to be made, and show the length of time you will spend on each.

Put first things first: Prepare your listeners with critical information first then follow with supporting information.

Research and prepare: Research your points beforehand to develop

your ideas. When speaking, state your findings and position, support your ideas and show examples, reasons, and list advantages, disadvantages and show cost savings.

Summarize the recommendation: Restate in one sentence the essence of what was just said.

Take a pulse: Get immediate feedback and confirm that the message was fully understood and accepted.

Keep it simple: Make sure the presentation was clear and concise.

NONVERBAL MESSAGES

Believe it or not, communication research indicates that two-thirds of the total meaning of a message can come from nonverbal cues. Our audience can greatly comprehend our presentation by paying attention to our nonverbal communication.

Nonverbal messages tell more than words alone and can pose some problems if misinterpreted. Nonverbal cues can dominate enough to distract the audience. Make sure that your non-verbal cues complement your verbal message.

Observed nonverbal cues consist of:

- Space
- Time
- Objects
- Movement
- Posture
- Gesture
- Facial expression
- Vocal rate or silence

Understanding Nonverbal Cues

Be aware of your verbal and nonverbal cues.

Negative cues examples include:

- Nervousness, embarrassment, or concealing something
- Avoiding direct eye contact
- Firm mouth
- Stiff posture or little movement

Reading and Written Communication

Reading must be done in order to understand:

- What to do
- How to do it
- Why
- When
- Who
- Where

The team member must absorb all the pertinent information available in a short time span. The team must become fully familiar with the project. Since Phase One entails gathering, understanding and absorbing large quantities of information, it can often seem that there is more information to absorb than humanly possible. Speedreading and key components searching are two solutions that can prove useful when digesting large quantities of information.

During this phase you should also freely jot down ideas and questions to discuss later during the creativity phase.

Let's assume at this stage of a study we have:

1. Understood the project
2. Determined functions
3. Created alternates
4. Ranked alternates
5. Selected alternates to further develop

At this point we get down to proving the results through effective writing.

Why is Writing so Important?

To survive in this business, writing is as important as breathing. Effectively written recommendations can be the single most important determination of a value study success.

Writing is an absolute essential at several critical points in the VE study process. First of all, writing shows how well you understand the item. Additionally, writing is often the best way to explain the proposed idea to someone else. Writing is also important in persuasion to prove that this idea is more effective, less costly, more productive, etc., than originally conceived. Readers greatly base decisions such as deciding whether to propose a change or whether to make a purchase or not based on their understanding of the material read during the studies.

Writing seems difficult for some people because it involves using two or more separate processes. First, writing requires *creating* putting thoughts on paper to be understood. Secondly, writing requires *critiquing* rearranging the words and sketches with a critical eye in order to make them as clear and concise as possible.

By nature, human beings don't make good critics and composers at the

same time. The secret to better writing is learning how to isolate those two functions and perform each separately.

Writing More Effectively

Writing is always a challenge, but there are things we can do to make it more manageable. In addition to some of the previous suggestions, use some of the following tips to better written presentations:

- Write in your own "voice"
- Write with reader's viewpoint in mind
- Make your point as quickly as possible
- Use a warm, self-confident tone
- State actions and anticipated time/cost to implement

Improving Readability

Your written materials could be the only chance you have to communicate. If your VE study is not understandable, your audience might not read it, ruining your chance to persuade and clarify. Helpful suggestions are:

- Results delivered on time every time
- Contents clear, concise, and attractive
- Neatly written consistent format

Value Report Elements

Elements of a report often include:

1. Cover
2. Cover letter
3. Table of contents
4. Title page
5. Executive summary
6. Listing of team members
7. Summary of recommendations
8. Recommendation with detailed convincing back-up
9. Cost model
10. FAST diagrams
11. Alternate idea listing
12. Idea ranking/rating
13. Development contrasting team proposal to original concepts
14. Implementation action—plan
15. Conclusions
16. Appendices

When the VE report is reviewed be sure to check:

- Is documentation accurate?
- Is all back up included?
- Are there loose ends?
- Is the proposed change understandable?
- Does it sell itself?
- Is it convincing?
- Are the functions basic?
- Focused?
- Is the original concept correct?
- Are advantages/disadvantages complete?
- Are rankings biased?
- Are costs inflated or deflated?
- Does it meet contract or project requirements?
- Can it be reduced and still convincing?
- Are the ideas easy to understand?
- Is it well organized?
- All questions answered/qualified?
- Proofread and checked by another team member?
- Read report with client viewpoint in mind?
- Has the report been read and re-read?
- Did it follow the job plan?
- Could something that is clear to you not be clear to the client?

After the report is issued, the team leader will answer questions and provide assistance with an implementation plan.

Do's and Don'ts for Conducting a Study

- Set in comfortable setting
- Plan ahead
- Distribute material and tentative agenda before study begins
- Bring needed equipment, supplies, references for study
- Concentration on study
- Be pleasant, neat
- Speak directly to others
- Avoid nervous mannerisms
- Be willing to understand concerns of others
- Keep own prejudices out
- Wait patiently for answers

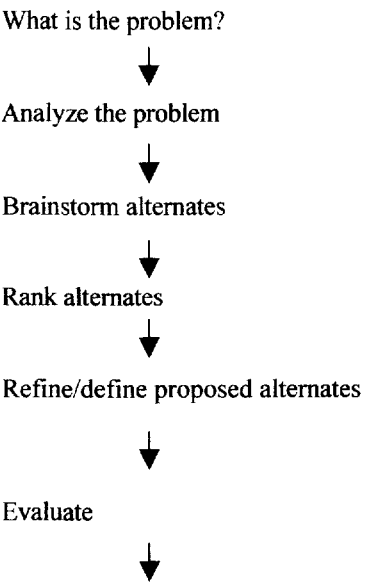
- Do not interrupt
- Avoid arguing

The MVO team leader's responsibility includes:

- Lead
- Facilitate
- Probe
- Inquire
- Suggest
- Uncover
- Draw out
- Guide

Brainstorming:

1. First, ask why
2. Why do we need *it*?
3. What should *it* cost?
4. What else can do what *it* does?
5. How long does *it* take to design? Manufacture? Construct? Replace?, etc.



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Making Effective Presentations

To provide for effective presentations:

- Outline the agenda to be covered
- Set a time limit
- Keep size to no more than 12
- Start on time
- Keep to agenda
- Invitees are to listen and not argue points
- Clarification questions may be asked
- State purpose of meeting and plans to be accomplished at the meeting
- Make presentation by all involved in the MVO study
- Outline steps to be taken after the presentation
- Keep discussion on track
- State that we do not have all the facts necessary to reach a conclusion at the meeting
- Take a short break if meeting bogs down
- Welcome all suggestions

- Do not allow ideas to be put down
- Focus on decision-makers
- Keep emphasis on issues and away from people
- Check to see if attendees understand the discussion
- Close meeting on note of agreements
- Distribute minutes within 24 hours and ask for any corrections to items stated
- Document key decisions

For a checklist of items to have prepared for the presentation refer to *The Value Engineering Theory Instructor's Guide and Student's Handbook* published by the Miles Foundation.

Incorporate the decisions made at the presentation in the MVO report.

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Managing Conflicts

CONFLICT MANAGEMENT

Conflicts are to be anticipated as a result of the work produced during the value study since the study results in another party being asked to consider a change. The change, however, should benefit the overall objective, but nonetheless change is hard to accept. Sometimes it is unavoidable. Conflict may seem negative but can be beneficial in a team setting.

- When expressed verbally, conflict can create energy that can be directed positively
- It gets feelings out in the open where they can be handled
- Confidence can be built because of the knowledge that the relationship can survive a disagreement
- It can promote genuine contact so that you deal with one another's feelings
- It can increase cohesiveness
- It can increase productivity
- It can lead to a real consensus
- It can lead to team growth
- It can lead to critical issue identification on the project
- It can lead to action initiation
- It can get problems resolved
- It can promote personal growth
- It promotes opportunities (nothing ventured nothing gained)

- It can lead to professional recognition since this team can effectively manage difficult situations

Where does conflict come from?

- Perception difference
- External pressure
- Divergent goals
- "Status wars"
- Value differences
- Competition

Each team member brings to the conflict different:

- Feelings
- Attitudes
- Beliefs
- Expectations
- Information
- Opinions
- Needs
- Desires

A consideration based on the above is *how* important are they to this challenge before the team. A conflict with a client during the presentation is going to be different than one encountered during the study. What is the best way to handle conflict? The first typical response is fear. Unconsciously ignoring conflict can lead to greater escalation later. It can be postponed or handled as it occurs. Depending on the situation, it probably should be dealt with directly as it occurs during the study.

Often studies require quick decisive action that is vital to the project. The course of action should be planned so that the unpopular or popular item is implemented.

In order to minimize conflict we should:

- Listen carefully
- Paraphrase the message
- Support the concept
- Provide well thought out answers to the anticipated questions
- Focus on problem, not people
- Seek out a common ground
- Avoid horsetrading

- Search for creative solutions
- Establish decision criteria
- Recognize that conflict is useful to avoid escalation
- Neutralize by restating questions
- Request more information
- List pros and cons
- Don't make them look wrong just so you can look right
- Get to win-win situation
- Be open
- Avoid defensiveness

As part of the study the team will present their findings to management. The presentation can be viewed as a conflict situation (bad news).

How to give bad news:

- It does not improve with age
- Don't over explain
- Be direct and specific
- Don't pass the buck
- State facts

Accepting bad news:

- Don't blast
- As for suggestions
- Is it really bad?
- Focus on problem
- How does a team member deal with negative responses to findings being presented?

Responding to blasts:

- Relax
- What's an alternative?
- Value the relationship
- Take action as soon as possible

When presenting the team's findings everyone should be reminded by the team leader that the team is making a presentation on their findings and are not in a debate. After the presentation the team will answer any questions regarding their findings.

People skills exercised during the value study are one of the most important aspects of the value study next to finding value improvement. So the team should pay special attention to attitudes and feelings and make sure everyone is aware of the team value improvement discoveries as they occur. The value improvement team is an extension of the client management (even though they operate as an independent evaluation team) so it is important to keep everyone informed of the work being done by the value review group.

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Phase 3: Evaluation Techniques

Various methods for evaluating ideas developed by the study are available. New creative and innovative alternative ideas to perform the same function as intended by the current design have been listed by the group. During the study the group have shown these on flip charts and entered them in the computerized report.

During the evaluation phase it is important now to focus on ranking the best ideas so that the group can focus on those for further development in the next phase. The group created new ideas in a frame of mind where any idea was a good ideas and was listed. During the creative phase the group kept any evaluation aside and listed all ideas. So now the group during this phase can determine which ideas have merit and which ones should be combined with other good ideas. Ideas that are listed that did not perform required functions are set aside.

Techniques used by study groups are numerous. A few methods are reviewed. One method used is one where new ideas are compared using evaluation criteria common to all on a matrix. Criteria are weighted and each is ranked against the original design concept once it has been ranked against the company or average score for similar scope. Each new idea is ranked from one to five. Five is the best score. Three is an average or no better than score. If the ranking is multiplied by the weighting given to each criteria item the resultant score is entered into the matrix. An example would be a ranking of four times a weighting of seven for a ranked score of 28.

Weighting criteria used may be an item's overall life cycle cost, time to build, ease of maintenance, design sustainability, impact on the environment, and/or ability to satisfy the user's need. The original item being reviewed may be

a steel column, with design alternates being a concrete reinforced column as option 1, and combination steel and concrete columns, etc. The original steel column may have scored a 90, the concrete reinforced column scored a 100, and the combination design scored a 110. The team usually further develops those items scoring higher than the original design. The team will discuss the advantages and disadvantages for each as the ideas are ranked.

Another method that may be used by the team to filter out best ideas is a ranking of a score from one to five. Five being the highest score on the alternate idea's ability to perform better that the originally designed item. One technique used by some agencies is to gather all the stakeholders in the room when the ranking evaluation discussion is taking place and have the group decide with a consensus score on the items that should be considered further.

Regardless of the method chosen it is the intent of the group to narrow the large lists of ideas to the best few that the group should develop further in the next phase. An example of the matrix evaluation format is shown below.

Idea	**Criteria 1**	**Criteria 2...7**	**Total score**
Weight	7	**1... use range of 1–9**	
Original Project item	4/28 (4 times 7 = 28)	4/4... use a weight of 1–5	All criteria = 90
Two	4/28	5/5...	~100
Five			Omitted
Eight	4/32	3/3...	~110

Since the items numbered two and eight were ranked higher than the original project item, the MVO team would develop those items in further detail in the development phase.

Other evaluation techniques are used by the practitioners depending upon the client requirements and the conditions that require certain methods for group decision-making.

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Phase 4: Development of Best Ideas

The main intent of the development team is to arrive at a workable alternative solution compared to the original design intent. Keeping in mind that the alternative must not sacrifice any of the intended functions being accomplished by the current design.

The team will clearly, concisely, and simply compare the value team's recommendation to the current design. The comparison will be complete with a narrative comparison, advantages, disadvantages, cost comparison, detailed cost estimates of initial and life cycle costs, sketches of both, calculations, vendor data, and any supporting information derived and developed to indicate the value added for accepting the recommendations. Each idea developed will be shown in the report. If the team generated one hundred alternative ideas in twelve categories, the team may develop a dozen new innovative recommendations.

A development worksheet was shown in Chapter 12 and a complete set of development worksheets are shown in the Appendix. A summary of the development worksheets will be included. It is recommended that the team also develop presentation materials in preparation for the oral presentation to management on the last day of the study or shortly thereafter. Benefits should be included so that the decision maker can make an informed judgment and decide to reject, modify, or accept the value improvement recommendations.

Development forms used by many MVO teams include the following:

1. Development form to contrast the MVO option to the original design
2. Sketch of the original design
3. Sketch of the MVO option

4. Cost estimate of the cost savings
5. Life cycle cost analysis
6. List of advantages/disadvantages for the MVO alternative
7. Justification indicating the need for the MVO option
8. Additional sheets, catalogue cuts, or supporting data to be included

The intent of the data included in the development section is to provide the reader with enough information to adequately make an informed decision on accepting the ideas developed for incorporation into the project. Refer to Chapter 13 for an example of a developed idea.

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Phase 5: Presenting and Reporting Findings

The team will present its finding to management upon completion of the value study. The merits of each idea presented should stand on its own. The ideas should sell themselves and the decision maker is able to make a decision that is in the best interest of the program after the presentation. In some complex cases the review panel may request additional information to make a decision.

The team leader should explain the value methodology used by the team to develop each idea that is being presented. Each team member will present the idea they were responsible for developing. A thorough review by the team is conducted prior to a dry run presentation. A dry run or two is suggested to fine tune the presentation being planned for management later.

Presentations should be simple and to the point. Material used for the presentation should clearly indicate to the observer the main advantages of accepting the ideas. Most ideas should sell themselves at this point. To the observer the idea would have many advantages over the original concept. The earlier this comparison is made in the design evolution the quicker decisions are reached. The later in the life cycle a comparison is made costs have been expended to get to this point so the advantages must be greater and redesign costs minimal in order to accept the ideas being presented. The time is limited for presentations. The quicker the team makes the point the better. Discussion on each topic may take longer than the presentation.

The team should make a pleasant presentation and be prepared to address the audience questions as this type of presentation is asking for management to accept a change in the way they may want to proceed. So it is important to have a well-prepared implementation plan. A plan should accompany the presentation that

outlines the steps necessary for proceeding with the idea. The plan may be complete with an action plan indicating assignments and deadlines in order not to delay related activities associated with the change.

Following the presentation the group needs to submit its report. Post workshop activities include issuing a draft report that is reviewed by management and other reviewers. Upon receipt of the comments on the draft report the report is finalized and sent to the client.

After the presentation report submittals and further analysis is needed by the team leader and team members to answer questions and assist with incorporation of the recommendations for value improvement. Examples of presentations made by groups are shown in Appendix A.

22

Getting Best Results

Breakthroughs have been formed by the use of value improvement techniques. How do we get what we want? We want to get away from the traditional approach, we want to control defects, experience better quality, reduce cost, and use methods that are within our control.

How do we get what we want? We are looking for across the board acceptance. We strive to provide an implementable plan. Our value improvements should be measurable. Without measurements the plan was not worth the effort. Results should be audited and the team should build in lessons learned for improved future value. Our efforts must be responsive. In order to improve the whole concept of value improvement a continual training program should be conducted and updated. In order for the whole value improvement program to succeed excellent results should be rewarded. After all each team wants to improve each time.

In conclusion, we get what we pay for. We all do not want the same value. We want it faster, better, cheaper. We want it ahead of time and under budget. We wanted it yesterday.

Needed are a few good value improvement professionals. Contact SAVE to find how to ride the wave of value practitioners as they explore, discover, and uncover ways to improve value on everyday challenges.

For more information on joining SAVE visit their website at www.value-eng.org.

For the value improvement terminology please refer to SAVEI publications that can also be found and ordered on their website address.

After taking the 40-hour Module I course the interested party may apply for the AVS exam. After successfully passing the exam this AVS certification is good for life (per the latest revised certification board memorandum). Those interested in improving value most likely strive to become fully certified as a value specialist or value management practitioner.

To study for certification an interested professional should understand the requirements as described in the manual located on the SAVEI website or published by the administrator. Consult a SAVEI member to be your advisor.

Trends indicate spiraling costs, scope creep, unnecessary costs, schedule related cost factors, unknowns, risks that can be mitigated and opportunity to control soft costs that are driving costs upward. Bidding climates in certain segments of the country may cause a false sense of security by forcing competitive prices that tend to offset the upward trends. Now is the time, if not before, to set up a value objectives study. Once one has been completed, the group identifies the advantages of using this methodology and soon begins to be a part of the overall process improvement.

Join the forces in improving the future by using the value methodology. Last year government agencies saved/improved their program budgets by more than $1.6 billion. Sometimes our goal is not cost reduction, but overall improvement in the program and the value methodology is the key to better teamwork and project understanding.

After the value improvement studies, during the design evolution, the work for improved value does not end. Post design value improvement efforts can continue to improve this or future endeavors. Lesson learned during this effort can be applied to future work, thus continuing to improve.

During stages of design/construction/operation/maintenance improvements may be obtained through the use of Value Improvement change proposals. Not only do these save time, money, they also improve quality, improve safety, provide for easier operation and maintenance, and accommodate future expansion plans.

As professionals we are striving to create solutions to simple and complex challenges. It is an inherent trait that we all want to better our future and ourselves. If you remember one thing from this value improvement methodology text, remember to focus on function.

23

Future Follow-Up and Implementation

It is imperative that value improvement teams follow up and provide the client with implementation plans. Results have been received from several studies and a few of the comments received from the review groups are included here.

In 1998, the author was the recipient of a national award for a MVO study conducted for the Florida Department of Transportation (FDOT). Again in 2001the author was a part of leading teams for FDOT to realize the nations largest transportation cost savings in Florida. The studies have focused on improving DOT construction projects and internal processes used for relocating utilities within its right of way, the right of way cost estimating process, and the transportation enhancement program process.

A partial list of some of the MVO projects, products, services, processes, and techniques that the author has been involved with in the past.

1. I-4 Auxiliary lanes from John Young Parkway to SR 436
Over 20 ideas were developed by the team for improvement to this design/build fast-track project.

2. I-10 Interchange
Improvements were recommended for management consideration to improve the interchanges near Jacksonville.

3. Module I and II Training
Nationwide training yearly to professionals interested in advancing work in value improvement.

4. Module I Training for Miami Airport and S. Florida Agencies 8/00
A training study conducted for professionals pursuing a CVS registration.

5. Module I Training for Bovis Lend Lease
An in-house training study was conducted for a private construction company.

6. Washita Battle Field Visitor Center
The visitor center was improved by tailoring the project to the site and conditions.

7. SR 436 from Beeline to Curry Ford Rd.
The widening project improved the project's constructibility.

8. Tri-Rail Signage
Improvements were recommended to improve the life cycle of the future signs. Life cycle costs for the proposed signage update was reviewed and life savings implemented.

9. Module I Training for Centex
An in-house training study was conducted for a private construction company.

10. Grande Dunes Resort
Developed over thirty ideas to improve the $78 million time-share unit facility.

11. Orange County Convention Center
The 20-member team developed improvement options for the civil, architectural, and mechanical/electrical areas ($65 million target).

12. LeJeune Flyover Bridge
The team developed maintenance of traffic and constructibility improvements.

13. Utility Relocation Study
Statewide utility relocation options were reviewed with industry wide expertise.

14. John Young Parkway Interchange
Realignment improvements were studied for the I–4 bridge crossing JYP to accommodate the ultimate I–4 location.

15. Lake Panasoffkee Bridge
Design/build options for the bridge crossing Lake Panasoffkee as well as the I–75 corridor.

16. Lake Monroe Bridge
Design/build options for the bridge crossing Lake Monroe as well as the I–4 corridor from 17–92 to Saxon Blvd.

17. US 90–SR Brown Rd to E. Commerce Blvd.
I–95 underpass improvements and corridor improvements were studied.

18. US 319 Crawfordville Hwy
Lane widening and future flyover options were considered.

19. US 1 (Philips Highway)
Corridor improvements were developed from I–95 near Jacksonville.

20. CR 470 Interchange
Improvements were compared and new options developed for the new planned interchange.

21. US 1 Reconstruction from 264th to SW 112
Planned widening improvements were reconsidered.

22. Florida's Turnpike-Boca Raton Data Center
Options were reviewed for improving the data center expansion plans.

23. Florida's Turnpike–Auxiliary Lane
The study focused on challenges to widen the turnpike between E-W expressway and the Western Beltway.

24. Florida's Turnpike–TB Manuel Bridge
The study focused on the Bridge options for crossing the St. Lucie canal as the bridge is widened and replaced.

25. US 441–SR 44
The study focused on widening improvements and environmental issues.

26. Florida's Turnpike–Western Beltway
The study focused on improving the complex interchange between existing I–4 and proposed Western Beltway on western side of Orlando.

27. NHDOT VE Study Keene–Swanzey
The study focused on improving intersections by grade separation. The team added value by improving the community aspects.

28. NPS Mojave Desert VE Study
Study was conducted in November 1999—options were developed to improve the location of the proposed site improvements.

29. Module I Training for FDOT
A training team of 16 studied three projects for improving roadway widening, seawall construction, and permitting process.

30. Module I Training
A training team studied the FIU Health care facility located in Miami.

31. Commercial Blvd. —Fl. Turnpike
The enhancements studied resulted in the improved operation at the location.

32. CR 207 VE Study for FDOT–D2
Study focused on improving the planned traffic lane addition and reviewing the corridor and drainage options.

33. Orville Wright VE study for NPS
This study focused on improving the value but maintaining the same architectural features to meet the 100-year celebration.

34. WASA Water Quality Study
Study focused on improved water quality and reducing construction and design times to meet regulations requirements.

35. Module II Training
Training techniques were used for the purposes of providing VE training tools and people skills for future trainers.

36. Miami Intermodal Center
A few options were determined to avoid an at grade intersection between the railroad and the planned upgraded airport connector.

37. I–4 Widening Study, Polk Co. to Client A
Study resulted in adding value by adding another lane for less cost now than in the future.

38. New River Gorge
Potential cost improvements ranged from $100 thousand for the $1.4 million project.

39. WASA Water Treatment Plant
Potential cost improvements ranged from $1 million for the $10 million project.

40. Blue Ridge Music Center
Potential cost improvements accepted were $1.1 million for the $3.9 million visitor center project.

41. Miami Intermodal Center
This pre-study workshop focused on determining areas of future VE study with three multimember teams, potential savings ranged from $1million to several hundred million.

42. Module II Training Manual
Training techniques were developed for the purposes of providing VE training tools and people skills for future team leaders/trainers.

43. SR 207 Widening near I–95
Potential cost improvements ranged to $5.5 million for the $30 million project.

44. Jacksonville Rest Area
Potential cost improvements ranged from $400,000 to $4 million for the $10 million project.

45. SR 207 Widening near I–95
Potential cost improvements ranged to $3.5 million for the $20 million project.

46. SR 26 Widening near Gainesville
Potential cost improvements ranged to $1 million for the $10 million project.

47. SR3/528 Beeline Interchange
Potential cost improvements ranged to $7 million for the $15 million project.

48. Noise Wall
Various alternatives were presented and accepted by the design engineer possible savings ranged to $6.6 million for the $18 million project.

49. SW 2nd Ave. Bridge Renovation
Range of potential cost savings ranged to $20 million.

50. Ft. George River Bridge
Improvements were presented to the decision panel for acceptance contributing to significant cost improvements for the $11 million dollar facility.

51. Miami Airport Concourse J
Improvements were presented to the decision panel for acceptance contributing to significant cost improvements for the $69 million dollar facility.

52. Module I Training
The teams studied various transportation projects throughout Florida. Potential cost savings ranged from $100,000 to $4 million.

53. Islands of Adventure Atlantis
Integral member of the scheduling team to review the contractors planned schedules to meet the owner's deadlines and turnover dates.

54. Isle of Capri Hotel/Black Hotel
Led studies on these projects located in Louisiana and Colorado. The team implemented cost savings for each project even though the projects were under construction.

55. Module I and II Training Seminars
Providing training to prospective value specialists nationwide at Boston, Denver, Chicago, Orlando, Tampa, Houston, Phoenix, and Atlanta.

56. Miami Airport Concourse H
Over six of the 12 new ideas presented to the decision panel were accepted, contributing to significant cost improvements for the $13 million dollar facility renovation.

57. Function Analysis Based Training
The team's efforts concentrated on developing FAST diagrams for several different transportation scenarios. Focus was directed at understanding project challenges and offering alternatives by understanding existing functions and finding options for improvement.

58. Talleyrand Port Access
The team developed improvements for the port access with the port and FDOT. Options submitted to the district added cost and value for the overall project, but determined an overall life cycle cost improvement of ($13 million savings for the traveling public and shippers).

59. I–275 from 5th to I–696
The team developed ideas for improving the project during the preliminary design stage. Implementation (2.2 million is being implemented).

60. Advanced Utility Relocation Study
The team of 12 brainstormed over 120 new and creative ideas to improve the utility relocations. Options submitted to the state included taking advantage of an open window of time between plans to owner headquarters and the start of construction and value for the overall project, but determined an overall life cycle cost improvement of $100 to $150 million per year statewide.

61. Right of Way Cost Estimating Process
The team brainstormed new and creative ideas to improve the current cost estimating process by reducing the level of effort and increasing reliability on cost estimates.

62. Midfield–Airfield Partnering Facilitation
Continued team commitment to contract goals.

63. Florida Overland Express High Speed Rail
Developed over 200 constructibility review improvements to the civil, o&m, financial, and technological sections of the $7 billion project spanning from Miami to Tampa through Orlando.

64. SW 2nd Avenue Bridge Reconstruction
In combination with the VE study the select group improved the constructibility of the Miami River crossing.

65. Program Wide Scheduling
Setting up scheduling guidelines, managing, and maintaining projects for 26 Vacation Club Resort site construction facilities around the nation.

66. Airport Expansion Program Manager
The team developed detailed planning through construction schedules, assisted with the financial management programs, led VE studies, constructibility reviews, claims avoidance review and support, and monitoring ongoing program development.

67. Light Rail Expansion
VE studies for the LYNX light rail program to entail a 10 year $800 million dollar light rail project planned in the Orlando area.

68. Central Artery Tunnel
Value study for two projects to improve the tunnel access.

69. US 131 Relocated Freeway
The team developed ideas for improving the project during the preliminary design stage ($500,000 is being implemented).

70. Eastside WWTP—City of Venice
The team developed new and innovative ideas for improving the project during the conceptual design stage. Implementation (ideas resulting from the VE study with the designer are being implemented).

71. SR 70 and Intermodal Center in Jacksonville
The team developed new and innovative ideas for improving the projects during the conceptual design stage. Implementation is being considered for implementation) Two projects were used for training the 28 FDOT personnel from maintenance, surveying, production, construction, and planning.

72. I–4 Orange Camp Rd. to I–95
The team developed twelve new and innovative ideas for improving the project during the conceptual design stage ($35 million was being considered for implementation).

73. I–4 Central Florida Parkway to Beeline
The team developed seven new and innovative ideas for improving the project during the conceptual design stage ($19 million is being considered for implementation)

74. I–4 Princeton to SR 434
The team developed eleven new and innovative ideas for improving the project during the conceptual design stage ($12 million is being considered for implementation).

75. 74th Street Interchange at Hialeah
The team developed new and innovative ideas for improving the project during the conceptual design stage ($2 million is being considered for implementation).

76. North Crossfield Taxiway
The team performed a constructibility review and developed new and innovative ideas for improving the project during the conceptual design stage ($3 million was being considered for implementation).

77. Army Helicopter Video Recorder
Project studied by VE training team during the 40-hour module I course. Cost savings for the project included video recorder upgrade improvements which are being considered for implementation (ranged over $3 million).

78. Animal Import Center
Project studied by the VE during 40-hour study included treatment of the animal waste before animals are released to USA. Cost savings for the project included improvements for the treatment system and site configuration to perform the same functions, and civil/structural improvements which are being considered for implementation (ranged over $200,000).

79. Apopka Vineland Rd.
Project studied by VE training team during the 8-hour introduction to the 40-hour module I course. Cost savings for the project included improvements for separating bike paths from traveled surfaces, paving, drainage, and civil/structural improvements which are being considered for implementation (ranged over $.5 million).

80. I–95/St. Johns Interchange
Project studied by VE training team during the 8-hour introduction to the 40-hour module I course. Cost savings for the project included improvements for phasing of bridge over I–95 until traffic warranted, paving, drainage, and civil/structural improvements which are being considered for implementation (ranged over $6 million).

81. Airport Parking Facility
Project studied by VE training team during the 8-hour introduction to the 40-hour module I course. Cost savings for the project included improvements for electrical, mechanical, landscaping, paving, drainage, and civil/structural improvements which are being considered for implementation (ranged over $1 million).

82. Detroit River Outfall Dechlorination
Project studied by VE training team during the 40-hour module I course. Recommended cost savings for the project included building modifications, the four teams recommendations included electrical, mechanical, civil/structural improvements which are being considered for implementation (ranged from $180,000 to over $1 million).

83. Embassy Suites Hotel
Project studied by VE training team during the 40-hour module I course. Recommended cost savings for the facade and piling areas of ($1 million).

84. Fellowship, Recreation, and Faith Hall
Project studied by VE training team during the 40-hour module I course. Recommended cost savings for the Rotunda and Roof areas of ($1.5 million).

85. Logan International Airport
Team recommended saving of $16.5 million for the airport expansion project budgeted for $94 million. (Module I training).

86. Central Artery Tunnel Alignment
The team recommended a 10% cost savings for the projects. Projects were estimated to be over $20.0 million.

87. Cajalco Creek Dam
Owner accepted $3-4 million of recommended cost savings for the $10.5 million dollar dam project built near Lake Mathews in Riverside California.

88. Northwest Orange Co. WWTP Exp.
Improved the 4 MGD expansion to the existing plant.

89. Seminole County Public Ad. Complex
Project consisted of a new Administration complex for county police, and security functions. $2 million in cost savings were recommended.

90. Philadelphia Composting Facility
Training seminar for AACE International.

91. Pinellas Reuse Water System
Recommended cost savings $500,000.

92. Tri-Rail Extension/Facility
Recommended cost savings: $1.2 million.

93. Cary Wastewater Plant Expansion
Recommended cost savings: $438,000.

94. USCOE Hangar
Recommended cost savings: $1.1 million.

95. Suncoast Expressway
Recommended cost savings: $ 13.9 million.

96. High School AAA
Project cost: $ 30 million, implemented cost savings: $ 1.9 million.
Actual low construction bids received: $28.5 million.

97. Discovery Middle School
Training study.

98. Suntree Elementary School
Training study.

99. Client A Celebration City
Infrastructure improvements were recommended.

100. Seminole County Expressway
Recommended cost savings: $17 million.

101. Florida's Turnpike Expansion
Recommended cost savings: $30.9 million.

102. Parking Garage
Project cost: $13.3 million, recommended cost savings: $3 million.

103. Church Street Redevelopment
Recommended cost savings: $200,000.

104. Old Floyd Road Bridge Cobb County. GA
Reviewed VECP cost savings: $100,000.

105. Bayside Bridge
Recommended cost savings: $2 million.

106. Boca Raton Water Treatment
Training study.

107. West Palm Beach Landfill
Recommended cost savings: $1.5 million.

108. Miami Metro Mover
Reviewed VE studies performed by consultant resulting in savings to rail and bridge construction.

109. Natchez-Trace Parkway
Recommended cost savings: $1.8 million.

110. Baltimore Parkway
Recommended cost savings: $3.428 million.

111. Iowa City WWTP
Recommended cost savings: $3 million.

112. Guyana WWTP
Training study.

113. Albuqurque Utility Renovation
Recommended cost savings: $2 million.

ACKNOWLEDGMENTS

The author acknowledges the clients, consultants, and others that contributed to the value improvements made as the result of the list above.

24

Blank Sample of Study Format

MANAGING VALUE OBJECTIVES

Insert picture of project

Value Improvement Study Summary

Study Number:

Study Location:

Study Title:

Project/Process/System/Technique Stage:

VALUE STUDY

PREPARED FOR:

PREPARED BY:

DRAFT

Date of Workshop:

Date Submitted:

Submitted by: (Name of CVS team leader)

VALUE IMPROVEMENT STUDY

TABLE OF CONTENTS

EXECUTIVE SUMMARY REPORT

Project Name

Date

INTRODUCTION

The Value program_____

SCOPE

The Value Analysis study_____

PURPOSE

The purpose of the study is_____

FINDINGS

The_____

CONCLUSION

The_____

Item	Description	Life Cycle Cost Savings	Status

VALUE ENGINEERING STUDY

AGENDA

DAY	DESCRIPTION
One	Project Overview
	Site Visit
	Designer Orientation
	Cost Model
	Function Analysis
Two	Creative & Evaluation
	Begin Development
Three	Continue Development
Four	Finish Development
	Life Cycle Cost
Five	Presentation/Report

LISTING OF VE STUDY TEAM MEMBERS

Name	Title	Phone/E-mail

BRIEF PROJECT SUMMARY

VALUE WORKSHOP

PRE-STUDY ACTIVITIES

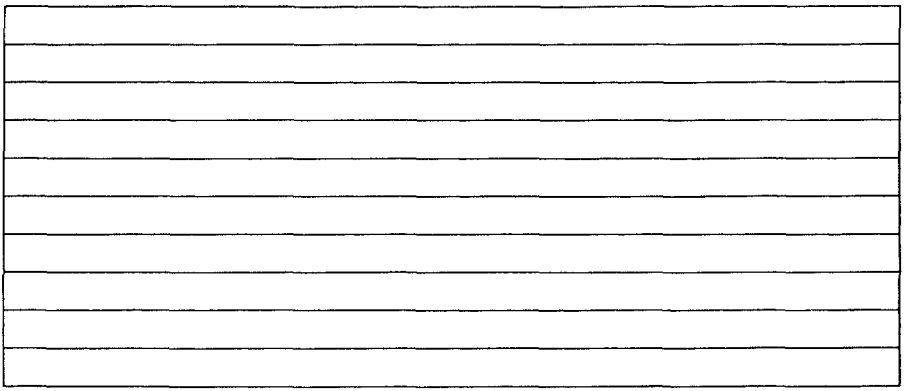
- **Select Project**
- **Determine Type**
- **Select Team**
- **Develop VE Package**
- **Identify Major Components**

VALUE WORKSHOP

PHASE ONE: INVESTIGATION (INFORMATION GATHERING) PHASE

- **Secure all the Facts**
- **Determine Constraints**
- **Develop Cost Model**
- **List Project Components**
- **Identify Basic Functions**
- **Determine Secondary and Supporting Functions**
- **Determine Worth**

HISTORY

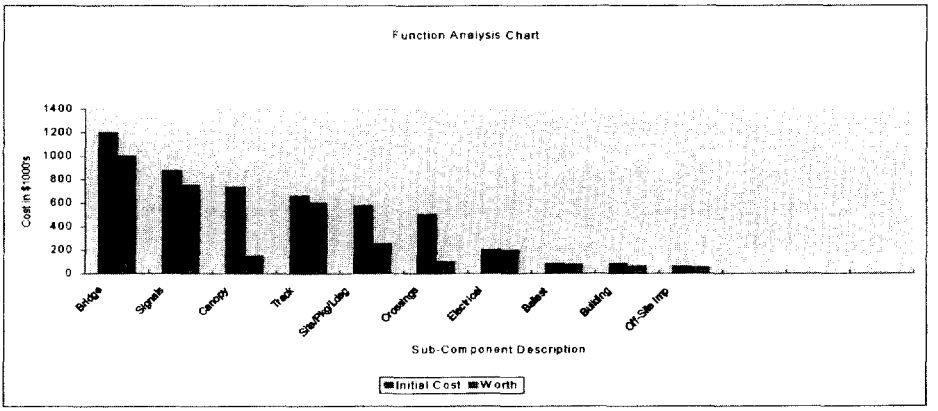


RESEARCH SOURCES

Item	Source

Cost/Function Model

ITEM	PRESENT COST	WORTH	Function Verb	Noun	$=1000s
Bridge	1200	1000	Span	Obstacle	
Signals	875	750			
Canopy	732	150			
Track	655	600			
Site/Pkg/Ldsg	577	250			
Crossings	500	100			
Electrical	201	200			
Ballast	86	80	Total	Total	
Building	82	60	Cost	Worth	
Off-Site Imp	58	50	4966	3240	



VE WORKSHOP

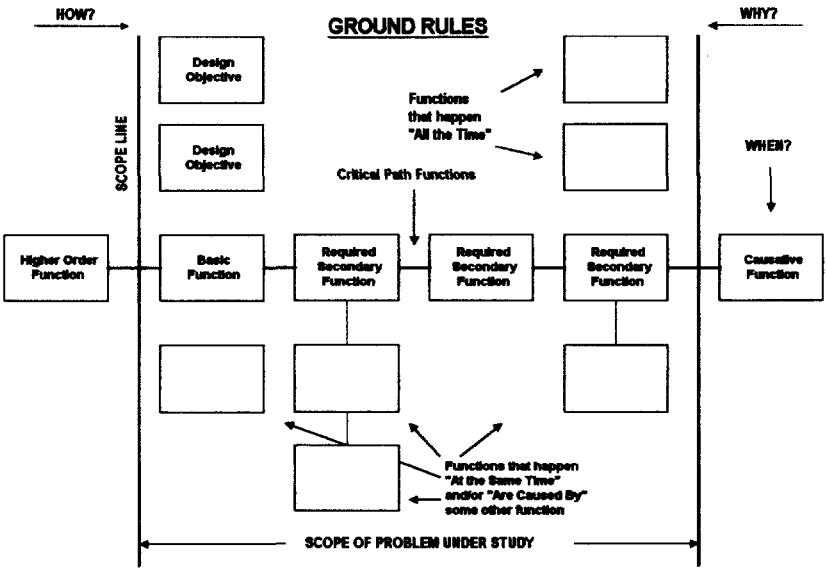
FUNCTION ANALYSIS

- **Assign Costs to Function**
- **Diagramming FAST**
- **Functional Analysis System Technique = FAST**
- **Function Cost to Worth**
- **Set Goals**
- **Eliminate Unneeded Functions**
- **Combine Functions**
- **Proceed with Needed Functions**

FUNCTION ANALYSIS TABLE

Item	Description	Function	Cost	Worth	Value index
		Verb/noun			C/W = VI

FUNCTION ANALYSIS SYSTEMS TECHNIQUE
Technically-Oriented FAST



VALUE WORKSHOP

PHASE TWO: CREATIVE/SPECULATION

- **Brainstorming**
- **Positive Thinking**
- **Can Similar, Simpler Methods Be Used?**
- **Move**
- **Compress**
- **Eliminate**
- **Modify**
- **Avoid Criticizing Ideas**

All members submit ideas.

IDEA LISTING BY FUNCTION

Item number	Description	Advantages	Disadvantages	Ranking

VALUE WORKSHOP

PHASE THREE: EVALUATION

- **Rank the Ideas**
- **Discuss the Advantages**
- **Strive for Group Consensus**
- **Obtain User Input**
- **Get owner feedback**
- **Compare New Idea to Original**

EVALUATION MATRIX

Refer to Chapter 12 for evaluation matrix.

Item	Desc	Eval	crite-ria						
		1	2	3	4	5	6	total	rank

VALUE WORKSHOP

PHASE FOUR: DEVELOPMENT

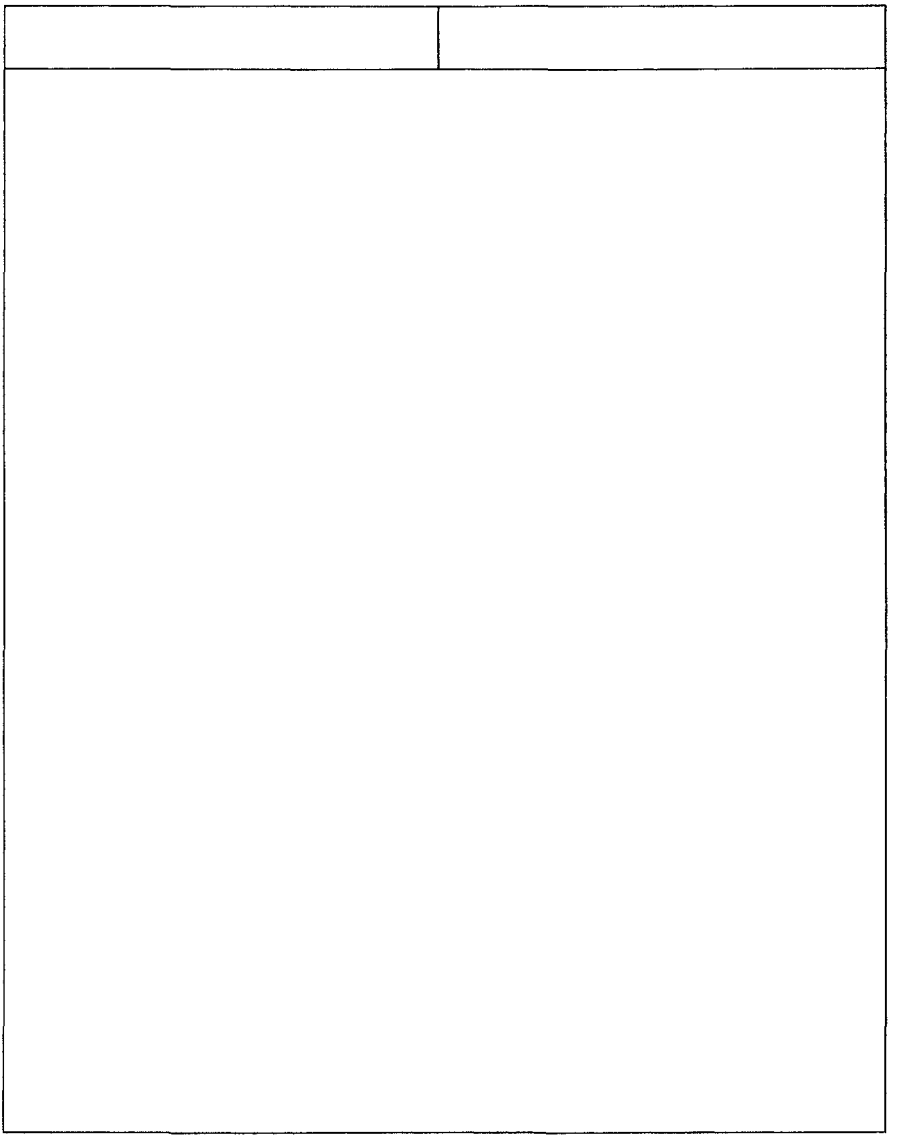
- **Will it Work?**
- **Is it Implementable?**
- **Exercise Good Human Behavior**
- **Carefully Scrutinize Ideas**
- **Ask the Experts**
- **Similar Ideas Combined**
- **Prepare to Explain the Ideas**
- **Compare Original to Proposed**
- **Advantages vs. Disadvantages**

Set the stage for further development.

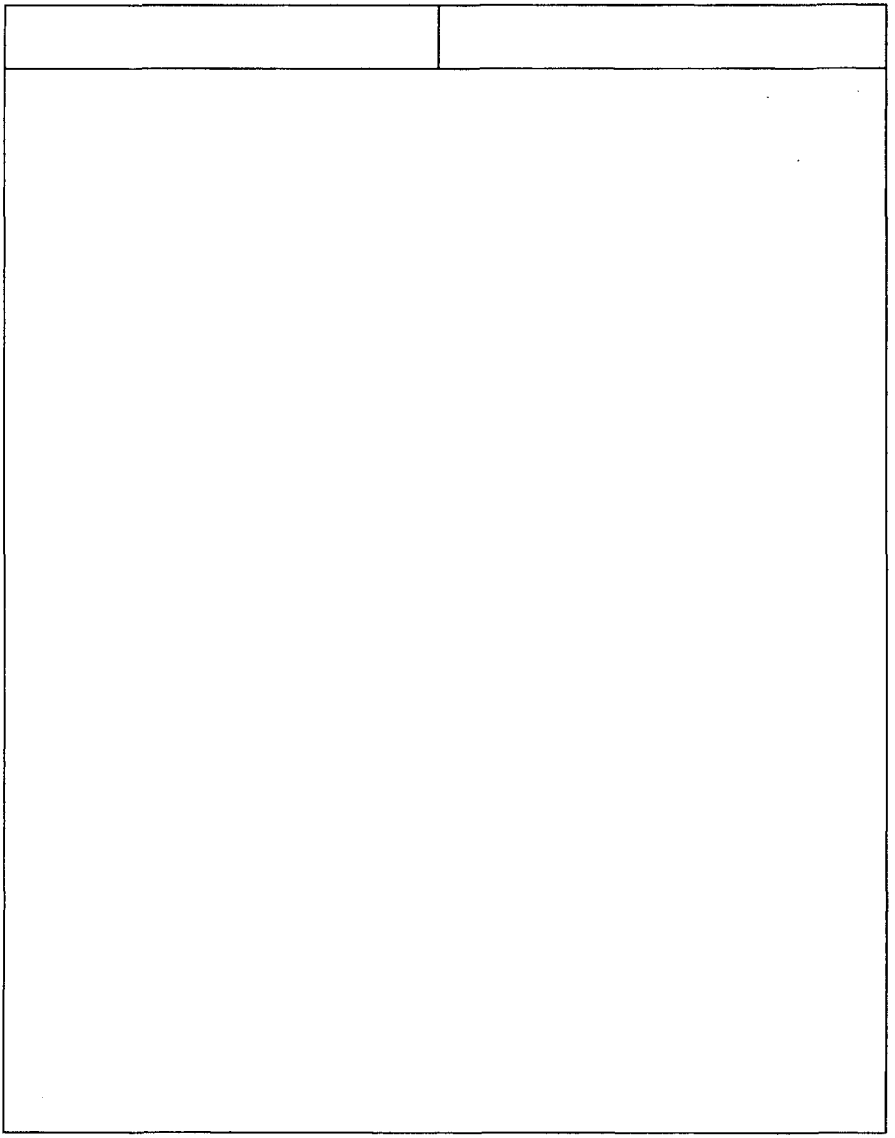
DEVELOPMENT FORMAT WORKSHEETS

Idea			
Description			
Original			
Proposed			
Advantages			
Disadvantages			
Justification			
Cost Savings			
Original	**Initial**	**Life Cycle**	**Total**
Proposed			
Potential Cost Savings			

ORIGINAL DESIGN SKETCH



PROPOSED DESIGN SKETCH



QUANTITY CALCULATIONS

DESIGN CALCULATIONS

RECAPITULATION

COST ASSUMPTIONS AND EXCLUSIONS

COST ESTIMATE COMPARISONS

Item	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Original Cost**	**Proposed Cost**	**Potential Cost Savings**

LIFE CYCLE COST CALCULATIONS

Initial Costs	Calculations	Original	Alternate One	Alternate Two
Life of Project	25 years			
Discount rate	4%			
Escalation rate	3%			
Other factors				
Annual Operating and Maintenance Costs				
Operating				
Maintenance				
Salvage/ Replacement Costs				
Total Cost Savings Annually	Show present worth comparison			

VE WORKSHOP

PHASE FIVE: RECOMMENDATION/PRESENTATION/REPORT

- **Format Presentation**
- **Fine Tune**
- **Resolve Issues**
- **Motivate and Convince**
- **Overcome Roadblocks**
- **Sell Ideas**
- **Explain Benefits**
- **Show Cost Savings**

Prepare an implementable plan.

NOTES FROM THE PRESENTATION

VE WORKSHOP

IMPLEMENTATION

- **Follow Up with Action Plan**
- **Assist to Drive Ideas**
- **Audit the Results**
- **Incorporate Improvements in Future Studies**
- **Scrutinize Designer Responses**
- **Continue to Sell Ideas**

Do not change function, but reduce cost and improve quality.

IMPLEMENTATION PLAN

Action Items
Responsibility

25

Midterm Exam

This exam is to be used for review only. The SAVEI AVS exam may be used instead of this exam. This exam covers chapters 1 to 24. This exam can serve as a review tool. This exam is not intended to portray the exam questions as administered by SAVE International. Answers are in Appendix B.

VALUE IMPROVEMENT TRAINING

1. Name the phases of the VE methodology used by the study team.

2. What is the basic verb/noun function for your pencil or pen you are using to write? Can you also list one secondary function.

3. Indicate the approximate cost of the basic function shown in number 2. Show the average total cost of the writing instrument; is it the same cost as the basic function? What is the basic function worth?

4. Indicate an alternative for the writing instrument's basic function.

5. What are the value indices for the writing instrument? Given VI = C/W, use the same cost and worth from number 3 and 4.

6. One purpose of the FAST diagram is to understand the scope?

7. Should a FAST diagram be developed for an item if all the functions are known?

8. What are two questions to ask when developing a FAST diagram?

9. Indicate a function of the following components of a building.
   Door
   Carpet
   Window
   Lights
   Television

10. Which of the items listed in number 9 would be considered a secondary function, if it were a fire station building?

11. Which is the most costly item, given the following:
    Trees 144 ea x $140/ea =
    Earthwork 1000 cy x $10/cy =
    Concrete work 200 cy x $500/cy =
    Paving 1500 sy x $15/sy =
    Doors 20 ea x $400/ea =

12. If the client would like to improve the items in number 11, which would be the first item to review, if the value index for earthwork is 1.3, paving is 1.1, doors is 1.0, concrete work is 1.33, and trees are 0.89? Given VI = C/W.

13. Calculate the cost per square foot for items shown in number 11 (exclude the trees) if the total cost is $100,000 and total square feet for the building is 1,000.

14. What would occur first on a value study, creativity or function analysis?

15. Which study would you prefer to be on if team A generated 15 ideas or team B generated 150 ideas?

16. Would you consider the study a success if the client accepted 60% of the ideas presented, even though those were 20% of the total value of all ideas recommended?

17. If the disadvantages outweigh the advantages for a recommendation should the team make the recommendation?

18. If alternate one recommendation included an initial cost savings of $1 million, would that be better than another alternate with an initial added cost of $1 million, but had a present worth total life cycle cost savings of $2 million over 20 years?

19. The life cycle cost analysis is all that is needed to convince the owner of a better idea?

20. Should two ideas be developed even though the owner would not be able to accept both at the same time?
21. Should the team leader allow one more idea to be developed one hour before the presentation of the major recommendations to the owner?

22. Should the team develop an idea that violates a constraint, even though the team ranked it high in evaluation?

23. If the original items cost is $400,000 and the proposed value team recommendation is $400,000 would the team present the recommendation anyway?

24. Determine the best value for using either stainless steel or carbon steel for a water storage tank, given that:
    Carbon steel costs $3/lb
    Stainless steel costs $5/lb
    Life of Carbon steel is 30 years Life for stainless steel is 50 years
    Owner expected life for the facility is 25 years
    Which would you recommend to the owner?

25. What is the initial cost difference between carbon steel and stainless steel given that 100,000 lb of steel will be needed to fabricate the carbon steel tank. Assume the stainless steel tank weighs the same as the carbon steel tank. Would you recommend the stainless steel tank even though the salvage value may be more than carbon steel?

TRUE OR FALSE

26. There is never time for VE.

27. Value improvement is only used for complex engineering projects.

28. More cost can be saved the earlier the value study is performed in design.

29. Value programs are only used to correct design deficiencies.

30. Aesthetic function does not count.

31. Secondary functions do not need to be analyzed, only the basic functions need to be reviewed.

32. Worth is the least cost to perform a function to a given set of parameters.

33. An ideal team is a multidiscipline team with one or more members from each discipline.

34. The value team should work on a study continuously for only 5 days.

35. The importance of the value study is the methodology approach, not the number of steps involved.

36. It is best not to involve management until the value team has reached their conclusions.

37. Brainstorming occurs first.

38. Do not question the specifications if it is a government project.

39. The team must agree on each idea submitted during the speculation phase.

40. Team members should evaluate ideas during brainstorming.

41. You should not question the constraints.

42. Additional constraints can be found after the team makes a site visit.

43. FAST diagrams are useful for breaking the problem into smaller pieces and determining if the functions are even necessary.

44. A FAST diagram has a critical path.

45. How, why, and when are three questions usually answered during FAST diagram preparation.

46. The idea generation process should be separated from the evaluation phase.

47. A group rather than the individual who created them should always evaluate ideas.

48. The ideas should be viewed from the user or customer perspective.

49. Use of a computer to evaluate the ideas is much better than a human.

50. Value engineering programs can be called value analysis programs, as long as it produces the same systematic approach to problem solving and value improvement.

51. Value programs should not be introduced during the construction phase of a project because it will cause delays and probably too many other changes.

52. Life cycle costing should always be included in the analysis because the owner may not only want initial cost savings.

53. Value engineering programs are just for cost reduction.

54. Adding value is one thing the team should try to do.

55. The team cannot proceed if they do not receive the information before the study begins.

56. The team leader might choose to adjust the agenda after the first day's meeting and decide to finish one hour later than scheduled.

57. The value team can verify the original cost estimate during information gathering.

58. A cost/worth model can be used as an indicator to determine where the team might focus their efforts.

59. The manager receiving the value study should direct the original engineering team to implement the value study recommendations.

60. The value study should provide an implementation plan.

61. There is less risk implementing certain ideas.

62. After a well-done oral presentation the team does not need to submit a written report.

63. Value improvements can become an organizational behavior.

64. No matter what the value team determines the customer must live with it.
65. The lowest life cycle cost is the best value.

66. Constructability and ease of maintenance can be used as two of the many evaluation criteria that may be used when comparing two competing alternatives.

67. It is a good practice to convert the total X year life cycle cost savings to a present worth of the life cycle cost savings.

68. Do not select a project for a value study if it is not a good candidate for potential savings.

69. If the item under study has good value already then the team should not pursue it.

70. Secondary function may have the highest costs.

71. Do not question city codes.

72. During the creative phase you should try to generate the greatest number of ideas.

73. Habits, lack of time, wrong information, customs, and culture can be causes of unnecessary costs.

74. Do not judge ideas offered during the speculative phase.

75. Value engineering or analysis (VE/VA) is only as effective as an engineering discipline.
76. The value, once determined, does not change.
77. Value improvements are difficult to apply to new designs.
78. Standard designs do not require value improvement.
79. Worth is the lowest total cost of a product.
80. Pareto's Law says that 20% of the items do not need to be studied.
81. One basic function of a pipeline is to transport fluids.
82. If the product now has a longer service life after the VE study then we have better value.
83. Value teams should not question the general conditions of the specifications.
84. Performance can improve while cost is reduced.
85. Maintaining good human relations is considered crucial to the success of a value improvement study.
86. Value studies are not required for projects that are on schedule and within budget.

ANSWER THE FOLLOWING QUESTIONS:

87. What is a basic function of an elevator? Could that function be studied?

88. What is one of the items to be covered on the value study agenda?

89. Assume one of the basic functions of a $70 million hospital is to treat patients. If the left scope line on the FAST diagram moved one function to the right would the scope of the value study change?

90. If the value index for HVAC is 0.79 how much is HVAC worth per ton if there is 185 ton costing $204,000? Assume VI = C/W.

91. If a cost to cover a surface of the wall varies from one material to another, would you choose the one that is best value or looks better?

92. How would you fix project A if it is 35% over budget, 9 months behind schedule, and the project is supposed to start construction in six months?

26

Managing Project Objectives

OBJECTIVES ARE ANALYZED BY THE TEAM FOR MANAGEMENT CONSIDERATION

When a team is needed to review a project for the purpose of improving the value objectives it is necessary to formulate a plan for managing the study.

The objectives of the study are to be determined. In order to assist the team leader conducting the major task of formulating a plan to conduct a typical study the material shown below can be used as a step-by-step process to conduct the job plan from beginning to end.

Project title	Location	Project number	Date

The team project agenda should be formulated as an example shown below:

Item	Day/time
Phase 1: information gathering	
Phase 2: creative	
Phases 3–5: (show all phases)	

The team would document all material being reviewed for the project.

Material reviewed	Document prepared by/date

The team would document the team participants.

Name	Title/phone

A cost/worth model and function analysis would be shown for major areas of the project.

Next, the team would create new and innovative ideas for the major functions.

Item	Type of function	Verb/noun	Ideas

An evaluation matrix would be used to screen the better ideas.

Idea	Criteria	Criteria	Criteria	Ranking

The team contrasting the proposed to the original concept can develop the best ideas.

Ideas	Advantages/disadvantages	Life cycle cost

The team would prepare the MVO report and presentation for management's consideration to implement value improvement ideas.

27

Letting the Job Plan Work

HOW CAN MANAGEMENT OF VALUE OBJECTIVES BE APPLIED?

The technique of MVO is governed by a structured job plan to assess the value of products or procedures. When unsatisfactory value is found, a job plan can be implemented. The plan involves the following phases:

General: Before actual work begins, a foundation should exist consisting of good human relations, teamwork, and management support so that an effective interaction can take place and work can focus on specifics.

Information/investigation: Secure facts, determine costs, and fix costs on specifications and requirements.

Analysis of functions: Define the function, evaluate function relationships (FAST Diagramming), and cost these functions. When possible, customer attitudes concerning functions are included.

Speculation/creativity: Establish positive thinking and develop creative ideas in a team setting.

Evaluation/development: Refine and combine ideas, establish costs on all ideas, develop function alternatives, and evaluate by comparison.

Presentation/recommendation: Present proposals that resolve the study issues and motivate to action.

Implementation: This is the phase of the job plan in which the proposal is implemented and the product is improved by acceptance of VE recommendation.

There are two keys to the value engineering discipline: (1) The phases must be taken in the proper sequence, as outlined above; (2) the unique method of func-

tion analysis must be used, and when appropriate, customers' perceptions of worth to the functions must be related. When cost reduction is the objective, this discipline can achieve impressive savings far above the norms of traditional cost reduction techniques.

WHAT IS THE TEAM LEADER'S RESPONSIBILITY?

The team leader will be called upon to formulate the best team to study the issues, costs, functions, and related factors associated with each project.

- Who should be on the team?
- What is the plan to conduct the study?
- What specific preparations are necessary for this team to reap the benefits (team dynamics)?
- Are there any potential human relations issues to be resolved?
- What should the study agenda include and at what time?
- Are there pre-prepared team study operations/formats that need to be changed for this particular study?
- There is an art to gathering the right information

WHEN SHOULD A VALUE STUDY BE DONE?

Problem Solving Systems

First of all, they must agree that we have a potential problem and that we are going to use the value methodology techniques to identify functions and estimate unnecessary costs. The teams agree to work together using the Job Plan to define, create, and solve the problem.

Human Relations

The problem solving system (job plan) will not work by itself. We must agree to work together to find solutions. It is helpful to put ourselves in the others' shoes and look at from a different perspective or a new vantage point. We must be willing to admit our findings for overall benefit of the project.

During the MVO effort we should have regard for others and respect the course of action they have been proceeding upon based on factors known to them at the time. We must be patient and seek to understand the work effort that has taken place before our involvement. Every successful effort takes a positive attitude by all involved. This is not an individual achievement, we are in this together. Efforts such as this require that the individuals as well as the team-combined effort be flexible in accommodating the time and effort of this group and the work of others. Since an MVO effort is one of short duration we have a

lot to accomplish in a short period of time and need the cooperation of everyone.

When we are investigating we need to listen carefully and document the findings whether they are in written form or verbally transmitted to the team. If a team member is actively involved with an area that needs special attention then he/she should be aware of the factors necessary to get the work done and if the need exists, be able to assign additional support to accomplish our overall effort.

When delivering our message to the decision makers the team leader should remind the members to be neat, clear, concise and willing to share the VE team's findings so that the group as a whole may make decisions on improvement.

Identifying Roadblocks

Information that is contrary to what has been discussed on a subject up to a certain point should be brought to the group's attention as soon as it is known. If a team member suspects that the group should or should not pursue an area in more detail it should be discussed. It is up to the team leader to bring this matter to light as it occurs. If required, as determined by the group or leader, the members are to be reminded of the objectives of the study so that they do not stray from the major goal. Team leaders should respect the chain of command and make a determination if the group should judge their thoughts based on certain factors (even if they are conflicting). Sometimes a "what if" scenario would need to be discussed so that we could judge if the option may be feasible.

Since MVO has the potential to create a change in one's work product, we can expect to receive some adverse reaction from those that are affected by the material presented to the decision-makers. The team should always exercise care when commenting on others' work. We would want to avoid criticizing the work. When new ideas are presented, the team will need the facts to back up the presentations made. Remind the team members to obtain copies of backup material from others or from any book that was consulted so that we may attach these copies to the alternative ideas being developed.

During the study it is helpful to summarize the findings by each member and to review the agenda to identify what we have accomplished and what is left to be done; by whom, and by what deadline. These efforts are only as good as the last study conducted by the group, including the team leader. Know where you are going, plan how you are going to get there, and modify the plan as necessary to obtain results on time. Improve future work products based on previous work and feedback from the team/decision-makers.

Types of Information

You are likely to confront roadblocks at each step of the job plan. Anticipate what information you need. Determine what functions are missing. What costs seem too high or too low. When creating new ideas explore but do not enter the sacred constraint zone. When evaluating, be fair and do not sway the group to make a

decision based on the team leader preferences. When developing and presenting an idea keep in mind what the makeup of the audience will be and how they might interpret the information about to be heard. What information is still missing (qualify the incomplete information)? Do not forget that after the presentation is over you should be willing to follow up with any assignment the decision-makers determine needs to be pursued and included in the report.

When gathering information it is helpful for the team leader to determine (based on the type of value study):

- What information is going to be needed?
- Who has the information?
- How many copies?
- What other sources of information is available and where?

Once the information is gathered, a determination should be made as to what was intended as part of the original scope. What does the project do now? What must the project do? In the case of conducting a value study on a process rather than construction the team leader may gather information based on the process now in place. Once a determination of the in-place process has been completed it may be helpful to compare it to other similar situations/processes to ascertain if and how the existing process might be improved. This may also be determined by interviewing those involved in the process on a day-to-day basis. Or in the case of a process that is more contractual or specification related, the team leader must investigate the opportunities that exist to improve the current process by questioning and getting the members to question how, when, why, where, and who is involved in the existing process. Following the job plan and letting it work for different situations can perform an improvement to the existing process.

It is imperative that the team leader's involvement and experience in these areas assist with formulating a plan that can be used to measure the success of the value improvement effort. As much or more improvement can be gained by studying process versus design/construction of projects.

Functions

Look at, identify, and classify the functions. Determine how they are being used and why are they needed and how much does each function costs, and by preparing a FAST diagram (discussed elsewhere). This FAST diagram can include the cost per function. The team may want to include the worth per function as well. Worth is the least cost to perform the same function or group of functions. By calculating the value indices, (cost/worth = VI) this indicator points to areas of mismatch where cost exceeds worth or worth exceeds cost. These indicate additional areas for the team to focus on during the study.

Function Steps During the Study

There is more to determining function than focusing on function during the analysis phase. The team focus is maintained throughout the study, especially during development of the cost model, function analysis, creativity (ideas generation), evaluation (judgmental), and development phases. Focus by the team is to make sure that the alternate item accomplishes the same function (possibly).

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Tips

COST MODELING TIPS

Generally 80% of the costs are in 20% of the items (Pareto's Law suggests that 20% of the population earns 80% of the wealth). Costs are to be modeled for all major function areas of the project.

By taking the estimated cost for a typical project the group may model the costs. But, before they do so they need to:

- Determine what costs are missing
- What costs appear low or high?
- Include the cost for unknowns
- Quantities may need to be checked and reviewed

Prepare parametric costs for comparison to the current estimate (cost/sq yd of pavement, for example).

Using the information from the instructor and sketch for the project being reviewed develop a cost model for the project broken down by major function area, (i.e., earthwork [support load], drainage [convey water], lighting [illuminate surface], etc.), handouts are to be provided by the instructor.

29

Project Analysis

PROJECT ANALYSIS USING FUNCTIONS

Why Take the Time to Analyze This Project?

- First, you may want to ask yourself or others what the project is for
- What can this design do for the team or public user?
- When should the alteration be made?
- Where should we start when we make the improvements?
- What part(s) of the job should we focus on?
- After assigning costs to functions or functions to costs we have determined areas for potential value improvement

We should discuss the worth of each function. The worth is a target. Keep in mind that it is not the group's intent to meet the target in all cases, but this type of thinking, at this point, generates some thought about why we need the function, how it is to be accomplished and when. It also gets everyone to participate and give his or her point of view as to how important each category of function really is to the overall project. In some cases, we might look at the function's cost and ask is it worth 50% of the costs to perform that function?

As part of analyzing any project, process or item under study, we would review the functions, cost, and worth. It is similar to managing a project; there are three key items of importance (cost, time, and performance).

When we study functions in more detail it becomes apparent that some functions are more beneficial to the overall project than others.

There are many items of importance to review when we analyze each segment of the project and it will be the team members' responsibility (expertise by area) to assist and educate the team as to the real cost that should be in the estimate for the item/function. And it is the responsibility of the professionals experienced in certain backgrounds to target the worth for particular functions. Take note though that the team leader should have some expertise in these areas to lead the team through the cost model. Often it is not apparent at first view of the cost estimate that certain costs are low or are not included. It becomes more evident that these costs are unbalanced after further review and discussion on each topic. Sometimes by reviewing the construction schedule timeframes for certain activities it may become evident that the costs may not match the work time and effort involved. The scope of the work may be more extensive than what has been identified in the estimate at this point. At times, the estimate may not include the costs associated with environmental permitting and other requirements that are different than what is in the database. Other areas that the estimator can pinpoint are related to factors for maintenance of traffic, mobilization, contingency, inflation, right of way, utility relocation, underground unknown conditions, cost of working at night or shift work, stacking of trades in confined areas, cost of money, demobilization and remobilization, site access, demucking, nonstandard fabrication, or costs associated with state of the art materials. The list can vary depending on the type of project under study and where the project is located.

Determinations of functions are very important. Team members often complain that valuable discussion time is consumed by determination of functions. Invariably however, when this phase is completed the team has a better understanding of the project with which they are about to get involved and understand the project from each other's point of view. This function analysis bonds the team into one coherent group joined for a common cause. For those members that are somewhat inexperienced in certain subjects this analysis serves well to get everyone up to speed.

Advantages of the function analysis are to get agreement from the group on the basic functions and to set the scope of project being undertaken.

Developing the FAST Diagram

When diagramming the functions on a project, just keep in mind the advantages provided.

First of all, let's gain an understanding of the FAST technique. Refer to Figure 1 for the labels.

the diagramming of the functions. Finding duplicate functions becomes more evident allowing them to be eliminated or combined with others with the same result. The most basic function identified to the left inside the scope line is determined and agreed to by the group. Setting the scope lines may be arbitrary and changing the lines changes the item under study. FAST helps us avoid a routine problem encountered by technical teams: coming up with the right solution to the wrong problem. With FAST the team can demonstrate that a thorough analysis has been made.

Avoid Traps

Ask how it is being done or why it is being done; rather than how can it be done or why should it be done? Those questions may be helpful after the original project FAST has been developed.

Diagramming Procedures

- List all functions as verb-noun (active verb and measurable noun)
- Write the functions on small post-it (stick-on) notes for easy rearrangement
- Involve the whole team (excellent team building work)
- Break down team barriers
- Help inexperienced team members grasp the problem
- Everyone participates in determining the level of indenture or importance (abstraction)

At this point we need to review the FAST components and techniques used by the team leaders in gaining a better understanding of the project components. Not only do we understand the project segments, more importantly we are building solid team understanding and beginning to:

- Determine design objectives
- Check for and identify missing functions
- Think ahead and identify areas of potential improvement
- Test the FAST diagram if it does not work find out where the problem areas are
- Use the Diagram to assist with creation of ideas in the creative phase
- Change preconceived notions
- Get involved parties to accept what the team has identified as their understanding of the scope and potential ways to resolve problems
- Find duplicate functions
- Help with possible elimination of unnecessary functions
- Get everyone to agree on the scope of the VE study
- More clearly segregates the basic and secondary functions

- Deepen the group understanding of the problem
- Demonstrate the teams understanding of the areas under study
- Objectively view the project
- Pinpoint value mismatches
- Identify the current situation and contrast possible improvements
- Diagram specific components or overall concepts
- Break down team barriers
- Grasp the understanding of all areas of the project
- Cement a team mentality

Drawing a New Diagram

- Start with post-it notes
- Ask how
- Ask why
- If a function answers the question why, place it on the left
- If the function happens at the same time it falls below the function
- Determine the critical path functions
- The most basic function is immediately inside the left scope line
- Ask the question, if we didn't have the function could we still perform the other functions?
- Scope lines of the item under study (see Fig. 1)
- Review the high cost/worth areas along with the verb/noun functions
- Higher order functions are outside the scope line to the left
- Lower order or causative function is outside the scope line on the right
- Divide into teams and develop a FAST diagram for a specific item—what is the basic function?
- Begin to think how the item could be improved, combined, eliminated or reduced. One person should be the leader of the FAST diagram solution.

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Creativity Process

CREATIVITY PROCESS AND MENTAL POWERS WITH PEOPLE SKILLS

Follow-on phases of the study stem from the effort that takes place during the creativity phase of each study. It is helpful for the team leader to get everyone in the correct frame of mind before starting this phase. When required the team leader may need to bring outside expertise in certain areas to bring in new ideas for the group to consider.

Creativity exercises may be beneficial to open everyone's mind and thought process. The team leaders would have the team work an exercise to get everyone to open their minds to solving problems and thinking out of the normal to arrive at solutions and also to promote teamwork.

The team leader should establish the "rule" to creativity. The rule is that no idea is a bad idea during this phase, as long as it does not conflict with the constraints documented by the team.

Everyone should participate in submitting new ideas to improve the function.

Start with the highest cost function first, since the team's effort should be spent in areas where there is greatest potential for improvement and where it makes the best use of their time.

During this phase there should no criticism of ideas offered by others, even if you think it is not worthy of consideration.

Write down all ideas submitted, and document each with a unique identifier

so they can be tracked (in other words it is not recommended to change numbers of ideas or have different ideas with the same numbers).

Using a technique such as thinking of how the function could be performed differently or how it was done on a similar project might help the group think of alternative ideas. It also helps to remind the group how we are doing the function now. Someone in the group may have to summarize for the others the way it works now so that we all have an understanding and can offer new innovative solutions. At times it may be useful to consider if there is a better location for the function to be performed so that is less costly.

Put yourself in the user's shoes, you may want mentally to form a picture of how the item works now. If you are having a hard time visualizing the situation have someone draw a sketch, view a video of a similar product or situation or take time to drive by a similar situation.

The team leader should allow some side discussion on topics (document conclusions reached). Documentation of these discussions should be included in the report.

Hints

- The objective of the creativity phase is to provide alternative ways to perform the same function.
- We want to analyze the problem not the symptoms.
- What would the alternative cost (rough estimate)?
- Could we offer new ideas if we thought of the ideal situation to perform the function?
- What did we do before?
- During the creativity phase we need to spend the time necessary to get as many ideas listed as possible. Ideas generated are evaluated later, but now we need to exhaust everyone's creative thinking so we leave this phase with as many ideas as possible.
- Referring to other problem solving techniques such as mind mapping, force-field analysis, fish bone diagramming, etc., may be beneficial.
- Think of similar yet simpler methods to accomplish the function.
- Standardize, move, compress, eliminate, modify, combine, less, and more are some good words to use with the function, and.
- Ask, is it needed?
- Is it accessible for maintenance?
- Are the specifications too restrictive?
- Does it require work during nonproductive times?
- Would you spend your money for this function, if not what are alternatives?
- Can a lighter material be used, thus reducing the foundation cost?
- Can native materials be used?
- Could we recycle some of the materials to save disposal costs?

- Do we need the finishes on areas not exposed to public view?
- Higher-level functions normally produce better potential for cost savings.
- Ideas for lower level functions are generally easier to implement.
- What may be new to one team member may not be new for everyone.
- Think of a newly invented idea or technology that may work in this situation.

Creativity: New Ideas and Approach

- Everyone has some creativity
- We know more than we think we know.
- Can be enhanced through training and practice
- The overall intent is to arrive at some practical solutions
- Sometimes we are stifled and think there are no other solutions, but the work of the group can find alternatives.
- Team leaders activity during this stage is crucial for finding solutions to complex, complicated, or insurmountable issues

Four Basic Mental Powers

1. Take time to *absorb* the information
2. *Think* about the current situation and ways to improve upon them.
3. *Retain* the information
4. *Imagine* the potential solutions. Later, *judge* as a group (next phase) if the possible solutions are workable

Creative Steps

First we need to:

- Define the problem
- Gather information
- Find the facts
- Understand the data
- Create alternatives
- Sort/combine those ideas with greatest potential
- Develop and bring the new ideas to management for consideration

Blocks to Creativity

Because we have been accustomed to doing things certain ways since we were young, we are not taught to work in a team framework, therefore it is a challenge

for the team leader to get the most out of each team. Often, during the study there is not enough time on everyone's part to allow themselves to be creative because of the fact that change, at this point, means more time and money to make the changes.

We are creatures of habit. Set perceptions, regional and cultural attitudes, pre-established emotions for or against, and attitudes garnered from bureaucratic experience must be overcome.

Creative Techniques

Create an atmosphere that allows everyone to think more creatively and try to avoid outside interference. Think outside the box and think of items that could improve the function. Team leaders should choose a time when the team can be most creative. Try to set the agenda so that team members are fully informed and are primed for this activity.

As a last resort use checklists to spark new ideas.

Cardinal Ground Rules

- Remind everyone that we should refrain from judging others' ideas. The intent is to get as many ideas as possible listed during the time allowed
- The quantity of ideas count, the quality check comes later
- Write down even the most impractical ideas due to the possibility that they may prompt others to think of a really good idea
- All ideas should be logged on the flip charts and hung on the walls in the room so that everyone can see the product of their time
- Take a break if everyone is bogged down
- If a need exists, consult with others to gain more ideas
- Allow for free flow of all ideas; at times it may appear that ideas are floating from everyone
- Try to keep all the ideas documented, but at the same time try to get them to jot theirs down and keep the discussion to one at a time
- Encourage the group to propose a modification of an idea already tabulated. Feed off one another
- Some ideas requiring further description may be submitted. They can be refined later
- Select a new team leader and have everyone in specific groups submit ways to improve a certain item, such as a new product to substitute for an every-day convenience

31

Types of Functions

TYPES OF PROJECT FUNCTIONS

Determine if the following exist on the project under study.

- Basic, secondary, required secondary
- All the time functions
- One time functions
- Unwanted functions
- At the same time function
- Dependent function
- Design objectives
- Time consuming functions
- Cost little now but a lot to maintain functions
- Aesthetic functions

From the value team's standpoint, determining functions takes time but the team leader/members need to take the time and make the commitment to determine functions and analyze them. After all, function analysis is what separates value improvement techniques from any other cost reduction practice.

Team involvement is crucial to the success of function analysis. The success of the study depends on this function analysis phase.

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Problem Solvers

PROBLEM SOLVERS

Scope of the Problem

Make sure that the scope of the problem under study is confirmed and that everyone knows and understands the problem. The team scope may be somewhat different after reviewing the overall problem. Preestablished constraints may remove an item from being studied by the team.

Team Qualities

In order to take on the challenge of solving problems there are certain characteristics that serve one well when taking on the team leader responsibilities to oversee the team's work studying the problem and providing solutions.

Some of the qualities include having:

- Imagination
- Initiative
- Stable personality
- Cooperative attitude
- Ample amount of experience and knowledge in the area to be pursued
- An understanding of the management and decision making processes
- Belief in the importance of the value methodology
- Ability to identify other opportunities for improvement

Alternate problem solving methods to FAST and evaluation matrices may need to be used depending on the situation.

Other methods that could be used include:

- Advantages vs. disadvantages matrices
- Force field analysis
- Risk analysis
- Weighted comparison
- Fish bone diagramming (cause and effect analysis)
- Multivoting
- Ranking by potential for value improvement
- Group discussion/decision making
- Internet ballot voting

33

Adding Value

A VALUE ADDED APPROACH: WAYS TO ADD VALUE

- We should take the time before we get so far into investigation to break down the original estimated costs by function.
- As needed the group may need to estimate the costs for confirmation of the original cost estimates.
- Focus of the group should be directed to potential high construction and maintenance areas.
- After determining the high cost-to-worth areas these become indicators as to where to focus on adding value.
- A review of the life cycle cost for the entire project indicates areas of potential improvement.
- Not only are we concerned with the construction and maintenance costs, but also a review of the energy consumption may indicate areas of potential improvement.

Cost Per Function

What is the cost to perform a particular function? Very seldom is a cost estimate prepared by function. So the design team has no real feeling for the cost to perform the function until we conduct our cost model during the value study. Not only are we determining function costs, we should also breakdown or combine function costs by major area, subcontractor-like work, similar material, labor crafts, equipment usage, etc.

By focusing on the value mismatch areas, those areas that have a high cost-to-worth or high worth-to-low cost areas, we can begin to pinpoint areas for adding value.

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Value Mismatch

FINDING MISMATCHES IN VALUE

Indicators of value mismatch include:

- Having several functions but not many contribute to the overall objective
- Few functions fulfilling the basic need
- Too much effort being spent to achieve a few functions
- Worth is greater than cost or costs are greater than worth
- Value of some functions are not contributing to the overall value

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Managing Time

TIME MANAGEMENT

Management of the time to perform the value study work is the responsibility of the team leader and designees.

The team leader needs to:

- Prepare an agenda and make everyone aware of what is expected and the time allocated to perform each task
- Individual task assignments should be made with deadlines so that all the activities can be achieved on time
- Every study is different, but the job plan remains the same
- The effort by the team should be directed at the end result. It is advisable to inform the team where we are at the beginning and end of each of the 5 phases
- Review the project schedule to indicate to the team how suggestions for change in certain areas would impact the overall program schedule
- Be cognizant of the time to design, construct, and maintain various portions of the job. We should also be aware of the cycles of repair, repaving, replacement, etc.
- Do not misinterpret the findings, take time to interface critical points with the original design team

Potential areas of improvement often relate to the amount of resources

needed to keep the facility operational. Take the time to ask the questions that will determine costs associated with the new facility. Many life cycle costs are significant contributors to the net present cost.

Use previous cost and time performance data when making average comparisons or use lessons learned from previous projects. Comparisons should be included in the report. Certain functions have strict time constraints and those constraints should be adhered to when offering new suggestions to save time related costs.

The time allocated for the study should be strictly adhered to. Great results are expected, on time, when the decision-makers are invited to attend the team's presentation on the final day of the assignment. We are only as good as our last study. Make sure a well thought out plan is developed in the beginning that is coordinated with all the parties involved. If we plan the work then we can work the plan.

36

Financial Breakdown

A REVIEW OF THE FINANCES REQUIRED FOR A FULL LIFE CYCLE OF THE PROJECT

The total life cycle of the project, product, program, item, or service cost will be reviewed. Assign costs to each area and function shown on a project of the reader's choice. Breakdown the costs into initial estimated costs, actual costs after completion, and long-term life cycle expenditures that are known or can be projected. All assumptions and qualifications should be listed when an item's projected cost is unknown. The reader may add any items they need to develop an entire life cycle cost for the facility they are proposing to develop.

After the costs are listed determine the team's area of focus. Where are the high cost areas? Should we focus on initial costs, or life cycle costs, or cost to worth ratios, or unbalanced expenditures to derive certain functions?

Item	Description	Present Cost	Life Cycle Cost	Cost/Worth
Up Front				
Construction				
Operation				
Demolition				
Total				

This is not meant to be a complete list of all costs, but can be used to begin to analyze a particular item or problem the team leader is confronted with.

37

Contracting Methods/Decisions

WHAT DECISIONS MUST BE MADE BY THE VALUE REVIEW TEAM TO REFINE THE CONTRACTING METHODS?

During project development the team usually has chosen the method to contract for construction/manufacturing/processing, etc. The VE team may consider alternative contracting methods to improve the value of the overall project. These contract methods can add value by reducing cost, saving time, or apportioning risk to the party best able to absorb it.

SELECTION OF THE BEST CONTRACT TYPE AND INCENTIVE SCHEME FOR CONTRACT COMPLETION

Presently your client has authority to implement the following alternative contracting methods (ACM).

- A (cost) + B (time) bidding
- Design/build
- Incentive/disincentive
- No excuse bonus
- Lane rental
- Liquidated savings
- Bid averaging method
- Lump sum (do not need to provide quantities)

The suitability of ACM is dependent upon a number of factors including:

- Market factors
- Availability of competition
- Complexity of work
- Location of work
- Likelihood of teaming or partnering relationship
- The best way to apportion risk for the given situation
- Potential for use of breakthrough technology

The team leader should lead a discussion or an abbreviated value study to determine the most optimum method for the case given.

38

Life Cycle Cost Components

COST COMPONENTS FOR A FULL LIFE CYCLE VIEW OF THE MVO TEAM RECOMMENDATIONS

A LCC comparison can be made to determine the most economical solution between competing alternatives. For the purpose of these case study examples shown the team leader will lead the team through any of the following life cycle cost comparisons. Several examples are shown for particular items that teams may confront when making life cycle cost comparisons for projects, processes, products, programs, systems, or techniques being reviewed. The team should work these or similar examples based on an item the may be analyzing on their project. Answers are in Appendix B.

1. The DOT is considering two proposals for a bridge replacement project. One alternative is a steel girder structure. The other is a concrete beam structure. Using the information below determine which structure is the most cost effective. Both structures have a 50-year life. Use a discount rate of 7% and perform an alternative analysis using 4%.

   Steel Alternative

Initial Cost =	$10,000,000
Annual Maintenance =	$45,700
Rehabilitation (year 25) =	$125,000
Salvage Value =	($1,000,000)

Concrete Alternative

Initial Cost =	$10,100,000
Annual Maintenance (years 1–25) =	$55,700
Annual Maintenance (years 26–50) =	$62,500
Rehabilitation Cost (year 15) =	$60,000
Salvage Value =	negligible

Determine the most economical solution.

2. The state is considering two proposals for a process improvement project. One alternative is to continue using the existing process to produce_____. The other alternative is to use the value team's recommendation using a streamlined process to produce _____. Using the information below determine which alternative is the most cost effective. The process has a 25-year life. Use a discount rate of 4% to perform an alternative analysis.

Existing Process

Initial Cost =	$4,000,000
Annual Maintenance =	$500,000
Reconfiguration Cost (year 5) =	$100,000
Salvage Value =	none

Alternative Process

Initial Cost =	$5,000,000
Annual Maintenance =	$100,000
Reconfiguration Cost (year 5) =	$50,000
Salvage Value =	$100,000

Determine the most economical solution. Determine the most economical solution using the team's own assumptions.

3. The financial institution is considering two proposals for a process/product improvement project. One alternative is to continue using process/product A to produce_____. The other alternative is to use the value team's recommendation to use process/product B to produce _____ for its customers. Using the information below determine which alternative is the most cost effective. The process/product has a 5-year life. Use a discount rate of 3% to perform an alternative analysis.

Process/Product A

Initial Cost =	$700,000
Annual Maintenance =	$50,000
Interim Cost (year 2) =	$55,000
Salvage Value =	none

Process/Product B

Initial Cost =	$550,000
Annual Maintenance =	$10,000
Interim Cost (year 3) =	$5,000
Salvage Value =	$1,000

Determine the most economical solution.

4. The manufacturer is considering three proposals for a program improvement project. One alternative is to continue using the following assumptions to produce_____. The other two alternatives use the value team's recommendation using the following assumptions to adjust the program produce _____. Using the information below determine which alternative is the most cost effective. The process has a 10-year life. Use a discount rate of 5% to perform an alternative analysis.

Existing Program

Initial Cost =	$14,500,000
Annual Maintenance and Operation =	$300,000
Program Upgrade Cost (years 1 and 5) =	$250,000
Salvage Value =	$1,000,000

Program Alternative Two

Initial Cost =	$16,000,000
Annual Maintenance and Operation =	$1,000,000
Program Adjustments (years 5 and 7) =	$15,000
Salvage Value =	$2,000,000

Program Alternative Three

Initial Cost =	$21,000,000
Annual Maintenance and Operation =	$200,000
Program Adjustments (year 3) =	$50,000
Salvage Value =	$5,000,000

Determine the most economical solution(s). The team may change the assumptions based on their variables/parameters.

5. The builder is considering three options for a technique improvement for the labor portion of the project. The original case shown below is to continue using the existing labor methods to produce_____. The other two alternatives use the value team's recommendation using the following assumptions to potentially improve the labor methods to produce _____. Using the information below determine which alternative is the most cost effective. The labor method has a 4-year life. Use a discount rate of 7% to perform an alternative analysis.

Existing Labor Method

Initial Cost =	$500,000
Annual Support Labor =	$13,000
Adjustments (years 1 and 2) =	($5,900)
Salvage Value =	2%

Labor Method Alternative Two

Initial Cost =	$450,000
Annual Support Labor =	$11,000
Adjustments (years 1 and 3) =	$5,000
Salvage Value =	2%

Labor Method Alternative Three

Initial Cost =	$760,900
Annual Support Labor =	$2,000
Adjustments (year 1) =	$2,000
Salvage Value =	5%

Determine the most economical solution(s). The team based on given parameters may change the assumptions.

6. The producer is considering three proposals for an operational improvement project. One alternative is to continue using the following assumptions to produce_____. The other two alternatives use the value team's recommendation using the following assumptions to adjust the operation to produce _____. Using the information below determine which alternative is the most cost effective. The process has a 6-year life. Use a discount rate of 4% to perform an alternative analysis.

Existing Operation

Initial Cost =	$4,769,450
Annual Maintenance and Operation =	$89,100
Upgrade Cost (each year) =	$56,000
Salvage Value =	10%

Operational Aternative Two

Initial Cost =	$550,989
Annual Maintenance and Operation =	$99,100
Upgrade Cost (year 4) =	$55,000
Salvage Value =	20%

Operation Alternative Three

Initial Cost =	$670,122
Annual Maintenance and Operation =	$100,000
Operation Change (year 5) =	$400,000
Salvage Value =	34%

Determine the most economical solution(s). The team based on given parameters may change the assumptions.

Life cycle cost analysis is the preferred method for determining the most cost-effective alternative. It is especially important in times of limited funding to determine where the funds should be allocated associated with the greatest benefits. Life cycle cost analysis is only a tool and judgment should be given to the other factors that may need to be included in order to determine the best alternative.

The following spreadsheet may be used to show the life cycle cost comparisons for the previous scenarios. The team may use their own spreadsheets to calculate the results. Reference the life cycle cost applications in the book *Value Engineering: Practical Applications for Design, Construction, Maintenance, and Operations* by Alphonse Dell'Isola, PE.

LIFE CYCLE COST CALCULATIONS

Initial Costs	**Calculations**	**Original**	**Alternate One**	**Alternate Two**
Life of Project	25 years			
Discount rate	4%			
Escalation rate	3%			
Other factors				
Annual Operating and Maintenance Costs				
Operating				
Maintenance				
Salvage/ Replacement Costs				
Total Cost Savings Annually	Show present worth comparison			

39

Cost and Worth Per Function

All cost is for function. The team may need to group the items into a single function, rather than studying parts and pieces of the cost estimate. Identify all major functions and separate functions as needed to gain a better understanding of the project. Separate functions into basic (must have) and secondary (desire, nice to have, may not need)

Given that Value = Function/Cost

Three value types include:

1. Esteem
2. Use
3. Exchange

Value index (VI) = cost/worth or some instruct that worth/cost may be used. As long as a ratio is used to determine if there is opportunity for improvement. A VI equal to 1.0 indicates that there is good value already (cost = worth). Therefore, the item may not need a value improvement study. Worth is the least cost to perform the required function.

Example: Bridge function _____ _____
Verb Noun

Bridge cost =_____

Worth =_____

Value index = C/W =_____

40

Financially Important Decisions

THE MVO STUDY CAN PROVIDE FOR BETTER DECISIONS FOR BASING FINANCIAL PLANS

Before the Study

- What was the budget?
- How was the budget arrived at?

After checking the estimate and reviewing the estimate qualifications/exclusions/assumptions one can determine the cost to make financial decisions.

After the Study

- Costs were reviewed
- Quantities were rechecked
- Assumptions were tested
- Scope was determined
- Worth established for each function
- Calculated the value index
- Created alternates to improve the value
- Calculated and compared alternates on LCC basis

The team needs to get buy-in from management on the potential for value improvement. Outline the implementation/action plan for acceptable options.

41

Team Building Skills

BUILDING SKILLS DURING THE MVO STUDY

The success of the workshop is dependent on the team leader's ability to produce the best quality and satisfactory results. How do we measure results of a study? Work products should be of a high quality, accurate, acceptable solutions, cost savings (improvement), and timely. Another yardstick measurement is the amount of ideas and amount of money accepted and implemented by the work program.

From the first hour that we gather to do the study, we need to understand each other and the project we are going study. Fortunately the team leader has a plan (Job Plan) to follow to accomplish the tasks of the study. At the same time we are working the plan we need to produce a great amount of work in a short period of time. The only way to do this is to work together, find out which person is best suited for each of the work tasks needed and have each, individually and as a team, meet the expectations of management, the team leader and the team. They want to produce great results on time and look toward the team leader to provide the direction needed for success. It is the team leader's foresight that can accomplish this.

Successful teams have a common purpose, a goal, a method to reach the goal and the talent and resources to accomplish the study. Team building takes on four major phases (form, storm, norm, and perform). During the study we follow the job plan (investigation, creative, evaluation, development, and presentation).

How do we meet the challenges of the study? Goals must be attainable. Feedback should be given for attainment of intermediate and overall goals. Incentives are helpful, and one built in incentive is the fact that the team gets to see the

ideas they created turn into acceptable implementable solutions destined to improve the project and future of the system.

Conflicts may arise from time to time during the study. Some conflict is good. It can lead to identification of the real critical issues that spurs action to resolve them. Everyone has different feelings, beliefs, attitudes, expectations, opinions, information, needs, and desires, but it is up to the team leader to foster the talents of the group for the best outcome.

Learning how to listen, speak, write, and read is critical to the success of the effort. Everyone wants a win-win situation as a result of the study, but is difficult when we are requiring change. So learn how to give bad news. State the facts, don't over explain, it does not improve with age, and be direct and specific. Once confronted with the challenges of bad news, find ways to make it into a positive for the team.

Planning for the Presentation

Outline an agenda, set a time limit, focus on decision-makers, rehearse the presentation, and keep everyone involved.

Dos and Don'ts

- Distribute material to the team ahead of the study
- Stick to the agenda
- Remain focused on the study
- Take a break when needed
- Remain pleasant
- Speak directly to others
- Be willing to understand concerns of others
- Keep own prejudices out
- Wait patiently for answers
- Avoid arguing

The Team Leader's Responsibility

- Lead
- Facilitate
- Probe
- Inquire
- Suggest
- Uncover
- Draw out
- Guide
- Get consensus

- Formulate a plan to conduct the study according to timeframes and constraints placed on the team
- Have the report prepared as you go
- Make decisions and get on to the next assignment
- Delegate tasks and assignments to the team to accomplish the necessary items of work

42

Function Analysis Diagramming

DIAGRAMMING THE FUNCTIONS BEING ANALYZED

Start from scratch, using the tools discussed earlier, select a team leader(s) and take one-half hour to develop a FAST Diagram on a set of assumptions

1. Life of project A = 5 years
2. Life of project B = 10 years
3. Cost of A = $100 million
4. Cost of B = $200 million
5. Maintenance cost A = $20,000/mile/year
6. Maintenance cost B = $40,000/mile/year

- Develop cost model
- Perform a function analysis
- Create ten new ideas
- Select one or two of the ideas
- Develop the best ideas
- Make a five-minute short presentation on the advantages/disadvantages at the conclusion of this exercise

43

Alternative Ideas

CREATING ALTERNATIVE IDEAS

Select one of the two: be creative and list ten to twenty new ideas (time limit: 1/2 hour)

1. Create new ideas for travel in the year 2050. What needs to be done between now and then to accomplish the new project?
2. Create new ideas for power generation to provide power to residences nationwide by the year 2020.

Each team leader may choose any topic other than the two shown.

44

Evaluating Best Alternatives

DETERMINING THE BEST ALTERNATIVES

All ideas should be considered. Which is the most used method? Choose an evaluation method to determine the best ideas using the criteria below and the ideas generated on one of the items in the previous chapter.

Name seven major factors used on the evaluation matrix for a roadway widening from two to three lanes in each direction.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

45

Presentations for Management

PACKAGING AND SELLING THE BEST ALTERNATIVES FOR MANAGEMENT REVIEW AND ACCEPTANCE

Provide a Well-Documented Package

Complete the package with the teamwork product. Summarize the activities that have taken place at each phase.

Sell the Package

Summarize the findings and contrast the team's proposal to the original design, including advantages/disadvantages.

- Attach sketches/estimates of cost savings complete with life cycle costs
- Include vendor sketches and other backup materials

Make sure the package is complete with the estimated cost improvements.

Include implementation plans for management's consideration when implementing the recommendations.

The team leader should lead the team through a presentation to management. Allow for a 30-minute presentation with no more than five minutes per persons presentation on each improvement idea. Make sure the management team gets an executive summary of the team's findings. Tell them what you want to tell them, tell them the team's findings, and wrap up the presentation with a summary of the overall findings.

46

MVO Program Enhancements

ENHANCING THE MVO PROGRAM

- Establish and update program guidelines
- Set goals (long and short term)
- Select a group of team members that are candidates for future studies
- Select team leaders from previous team members
- Continue to cross train
- Allow professionals to gain diverse experiences
- Pay attention to details
- Set aside and schedule projects with best opportunities for improvement
- Program should be stand-alone
- Known as independent (on-purpose) analysis
- Steering committee behind the VE program
- It is a catch-22: if you have a program you must make it work, if you don't have program the value of goods you offer may not be as good
- Push the program to get results
- Audit results
- Stretch program to do more
- Keep the organization growing
- As MVO goes so does the organization
- Value programs should operate as if it were there, but not there

- Results get monitored and published
- Recognize those involved

It is assumed that organizations have a value program already. It is the responsibility of the value program manager to establish initial program goals and to keep the program on track with continual improvements being implemented to improve the organizations goals.

47

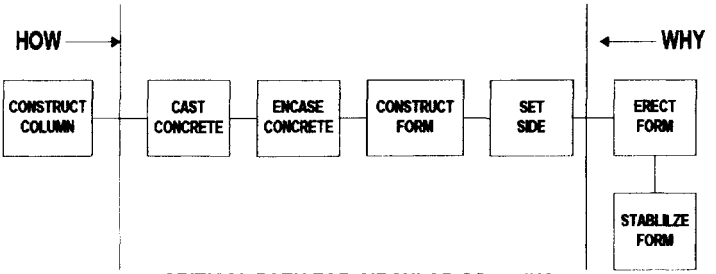
Solving Technical Problems

TECHNICALLY ORIENTED FAST

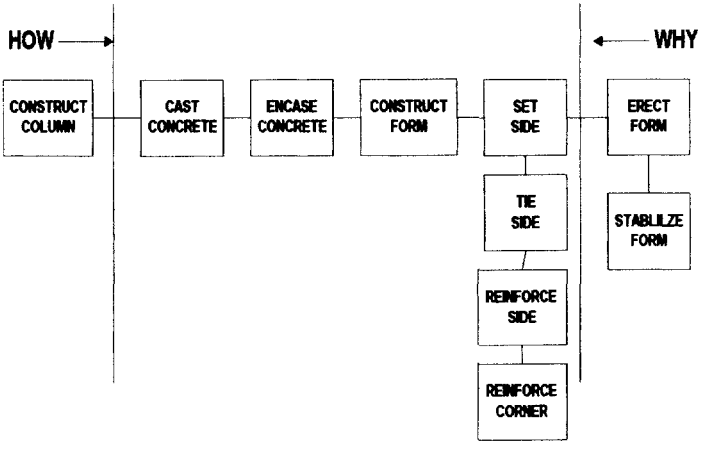
Review the bridge column FAST diagram on the following page. Which is better, the round or rectangular column? Which presents less cost? Cost-load the FAST diagram. What are the cost savings?

The difference in cost between circular column and square column formworks is $683.90 – 557.90 = $126.00. The difference is due to the necessity of certain functions in square columns. These additional functions are shown in the figure below.

The reader should explore solving a technical problem using the technically oriented FAST diagram as a tool to help identify some potential improvement areas [1].



CRITICAL PATH FOR CIRCULAR COLUMNS



CRITICAL PATH FOR RECTANGULAR COLUMNS

REFERENCE

1. T.J. Snodgrass, M. Kasi. *Function Analysis-Stepping Stones to Good Value*. Madison: University of Wisconsin, p 60, 1986.

48

Breaking the Problem Down

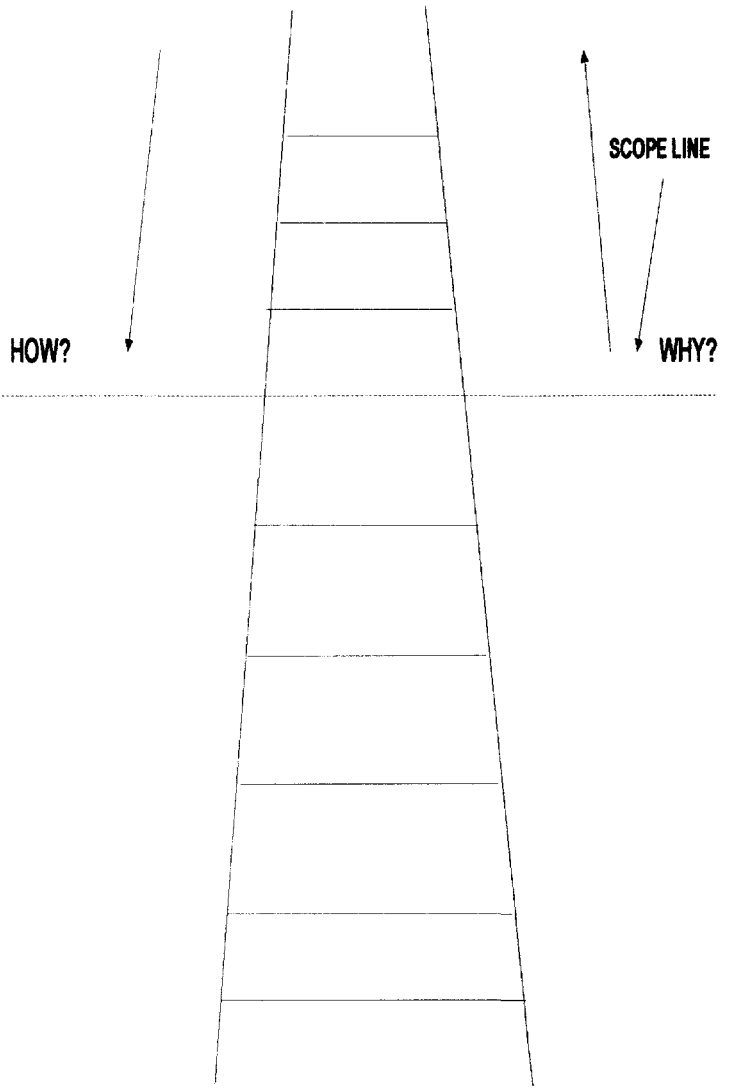
LADDER OF ABSTRACTION

In this problem we are going to diagram the functions vertically in lieu of horizontally as we have done with previously FAST diagrams.

Draw a ladder of abstraction similar to the one shown on the next page, for the newly planned project in your company, such as a park expansion, or improved financial planning system.

The team leader should lead the team through the ladder of abstraction exercise.

Ladder of Abstraction



REFERENCE

T.J. Snodgrass, M. Kasi. *Function Analysis-Stepping Stones to Good Value*. Madison: University of Wisconsin, p 22, 1986.

49

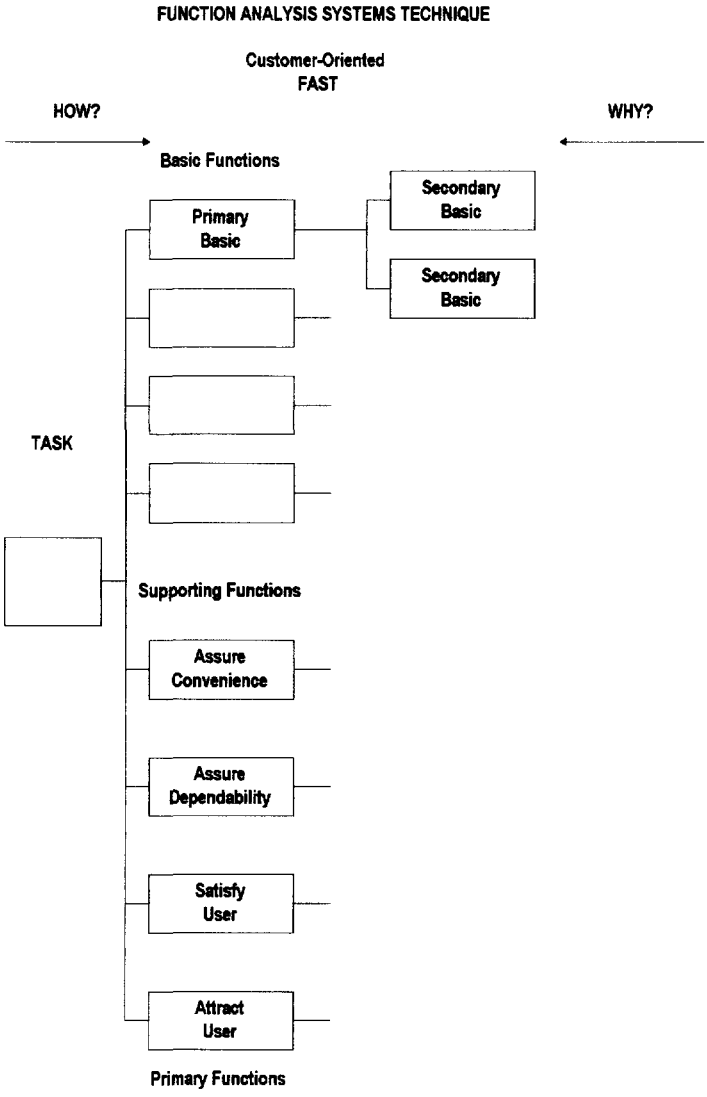
Customer Focus

CUSTOMER ORIENTED FAST

This diagram may not have a common causative function, but all customers may have same basic function (objective).

As shown on the next page the team should be led by a volunteer and diagram functions for a problem within their company, such as a new concourse at an airport.

As a second example, draw one similar to the one shown on the following page for a new interchange.



REFERENCE

T.J. Snodgrass, M. Kasi. *Function Analysis-Stepping Stones to Good Value*. Madison: University of Wisconsin, p 22, 1986.

50

Leading a Session

LEADING A TEAM FAST DIAGRAM SESSION

The team leader needs to:

- Get input from all stakeholders and team members
- Establish an existing format for the original project
- Create an alternative diagram based on possible improvements to the original method already in place
- Obtain buy-in from all parties
- If sessions held separately, bring group together at common points to interface and coordinate
- Keep it simple
- Look for holes or out of ordinary work processes

Once the diagrams are completed, test the diagram to see if it answers the how, why, and when and at the same time functions to make a determination by the whole team on the most basic, higher order, and secondary functions.

Review the diagram from a timeline perspective, that which indicates shortened or lengthened durations from what is needed or expected.

51

Discussion Groups

GROUP DISCUSSIONS

The team leaders should discuss ways to involve the team and produce the best study to meet the objectives. Use this as a review of the material and bring in any new information that has not been discussed in great detail at this juncture. The team could also take notes of items found from the discussion of ways to improve a study they just completed. The intent is to learn from the discussion and items noted to build into future studies for continuous improvement.

52

Overall Component Analysis

SELECTING OVERALL PROJECT COMPONENTS FOR A STUDY

Select the following for analysis:

Interchange between interstate highway systems.

List four basic functions

1. _____
2. _____
3. _____
4. _____

List five secondary functions

1. _____
2. _____
3. _____

4. _____

5. _____

Other examples may be used, given the team make up. The objective is to study a complex overall program by reducing it to the major functions that the team should focus.

53

Specific Component Analysis

ANALYSIS OF SPECIFIC COMPONENTS AS PART OF AN OVERALL PROGRAM

Now the team should review a specific component within an overall program. Select the following for analysis:

Components to be selected:

- Guardrail on the major interchange
- Traffic signal at the end of the ramp intersecting with a cross road
- Drainage piping and box culverts
- Bridges
- Pavement system
- Maintenance of traffic phases
- Landscaping
- Adjacent trail system
- Change order system
- Personnel operations in a department at the toll collections system

List a few ways to improve an item listed above (using the job plan).

54

Summarizing Study Results

SIMPLIFYING THE MVO STUDY RESULTS

A team leader should prepare the team to present the study results to management. The team leader should do the following:

- Have an agenda in advance
- Tell them what you are going to tell them, tell them, and then tell them what you told them
- Be brief
- Get everyone's participation
- Introduce the value improvement team
- Review actions taking place during the study
- Take advantage of the expertise on the team
- Set time limit and stick to it
- Rehearse, know your subject
- Anticipate, anticipate, anticipate
- Have a fallback position if certain ideas are not accepted
- Summarize after the presentation
- Assign action items as noted during the discussion
- Make eye contact about 75% of the time with the audience
- Focus on the decision-makers
- If there is a question during the presentation, make no excuses, have the question answered, or follow up if an answer not derived during meeting

- Take control of the meeting
- Avoid nervous mannerisms
- Speak up and speak clearly. Look at the audience not the prompt
- Lighten up the audience
- Show enthusiasm
- No need to thank the audience
- Press for a decision if we are ready at this point
- Remind them that the draft written report will be delivered in a few days to the program value specialist for distribution. Press for a resolution meeting.

Focus on getting good results on time, every time.

55

Exam Review

This exam is to be used for review only. The SAVEI AVS exam may be used instead of this exam. It covers chapters 1 to 55 and can serve as a review tool. The exam is not intended to portray the exam questions as administered by SAVE International. Answers are in Appendix B..

Answer the following questions:

1. The team leader should prepare the plan, draft an agenda, identify information needed by the team, and prepare a budget during a pre-study phase.

2. The team leader helps the owner determine who should be on the team.

3. The team leader should make sure that everyone attending the study has signed the sign-in sheet.

4. Ideas can be generated by brainstorming on each function taken from the FAST diagram.

5. The job plan will not work without the team leaders involvement.

6. Constraints are determined early in the job plan.

7. A FAST diagram can be cost loaded.

8. The term "value," as it relates to the field of value improvement is determined by: (circle correct letter)
   a. The manufacturer
   b. The buyer
   c. The seller
   d. The value engineer
   e. The design engineer

9. The team should adjust the cost estimate upwards if the team determines that items of scope are not included in the original estimates.

10. Parametric costs may be used to compare to the original cost estimate to determine the worth and determine if the estimate may be high or low in some areas compared to historical parameters.

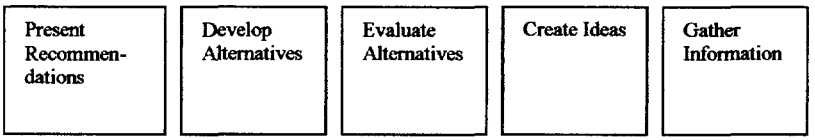
11. If one cost estimate item contains 50% of the cost of the total items cost of the item is always a basic function.

12. What is most important to the success of a value study?
   a. Discovering the most economical solution
   b. Maintaining good human relations
   c. Proving that value needs to be improved
   d. Developing a solution that is easily implementable

13. Select the true statements:
   a. Value engineering should not be applied during construction or operation because of the cost of making changes or the possible delay in schedule
   b. An important reason to do a VE study is to identify and correct design deficiencies
   c. All architects and engineers perform value, therefore no specific contractual clauses are needed in design contracts
   d. Value studies are needed on projects that are within the budget and on schedule

14. What are the functions of a cost model in the value study process? List at least three.

15. Are any items in the FAST diagram shown below out of order? If so, please draw the functions as they should be shown.



16. If the basic function of an elevator is to carry goods/people. What is an answer when we ask "why does the elevator carry goods/people?"

17. Given: there are two types of FAST diagrams: technically-oriented and customer-oriented. Development of each diagram can identify the basic function and critical path functions.

18. A FAST diagram can help the team identify duplicate functions?

19. Everyone has some creative ability. All ideas should be documented as they are submitted during the creative phase.

20. A person caught judging another person's idea is not allowed during creativity phases.

21. Would it be a good investment to spend $10,000 in conducting a value study and redesigning the project per the items listed in the cost model below. State your answer and reason for it.

Cost Model

Office building	50,000 gross square feet (sf)	
ITEM	Cost	Worth
Basic bldg.	47.12/sf	35.80/sf
Site work	4.91	4.00
Gen. & spec Conditions	6.42	6.00
Structural	4.64	4.75
Foundation	2.91	2.50
Structural	1.73	2.25
Architectural	14.95	9.25
Ext. wall and roof	9.59	5.00
Int. const.	3.29	2.50
Int. finishes	2.07	1.75
Mechanical	10.98	7.80
Electrical	5.22	4.00

22. What is the value index for plumbing if each fixture is worth $675? (99 fixtures, cost = $83,500)

23. If the value index for HVAC is 0.79, how much is HVAC worth per ton? (cost = $204,000, 13 tons)

24. If a concrete sidewalk costs $3.50 per square yard and grassing costs $1.50/sy, is the open paving on this project good value? (assume: open paving [parking, roads], $25,214 for 98,100/sf).

25. Value study programs should be enhanced when management is supportive of the program.

Appendix A

TRAINING INFORMATION

TRAINING SLIDES
INTRODUCTION AND MODULE I

VALUE ENGINEERING
ANALYSIS
AND
METHODOLOGY

VALUE ENGINEERING

Established by SAVE International
Originally began with General Electric
(Lawrence D. Miles)
Used the value methodology as a tool to improve value during World War II

Methodology improves value while maintaining intended functions on purpose

SAVE INTERNATIONAL

A Worldwide organization with active members in over 35 countries

CERTIFICATION PROGRAM

Levels of Certification:

Associate Value Specialist

Value Methodology Practitioner

Certified Value Specialist

HISTORY

1947: L. D. Miles Methodology
1952: Miles Workshops
1959: SAVE formed
1950s: Current-Government usage of VE
1973: CVS Program
1993:OMB Circular requiring VE
1996: PL 104-106

Reference: Value World Editorial by J. Michaels, CVS October 1997

RECENT VALUE IMPROVEMENT HISTORY

Public Law 104-106 requires government branches to use the value methodology on all budgets over $1 million, not just defense budgets

PUBLIC LAW 104106 READS

- *Each executive agency shall establish and maintain cost effective value engineering procedures and processes.*
- "Value Engineering" means an analysis of the functions of a program, project, system, product, item of equipment, building, facility, service, or supply of an executive agency performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety, and life cycle costs.

CONTRIBUTING TO OVERALL SAVINGS

Each agency contributes to using the value methodology generating savings and allowing more to be accomplished with less funds

GAO estimates that 3–5% of the budget can be saved each year

Reference the Hoving Group recent publication

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VALUE METHODOLOGY GUIDELINES

SAVE Value Methodology Standard

ASTM E-1699-95

Agency Procedures

Private Company guidelines

PROJECT SELECTION CRITERIA

- Potential for improvement
- Location
- Rushed timeframe
- Related issues
- Over budget
- Unbalanced parametric costs
- Functions need to be refined
- Related to a similar improvement study

PRE-STUDY PHASE

- Select project
- Select team
- Establish budget
- Set agenda
- Select location
- Gather documents
- Determine requirements

TEAM MEMBERS

- Leading experts
- Authors
- Mediators
- Negotiators
- Fact finders
- Presenters/reporters
- Comfortable with job plan

THE JOB PLAN

- Investigation/Information Gathering
- Cost Modeling
- Function Analysis
- Creative/Speculation Phase
- Evaluation Phase
- Development Phase
- Life Cycle Cost Analysis
- Presentation/Reporting Phase

IMPLEMENTATION

After the study the accepted recommendations are implemented into further work improvement plans

CORE TEAM

The Value Improvement team is supported by outside expertise as needed during the study to enable to study to maintain an adequate pace

PHASE ONE: INVESTIGATION/INFORMATION GATHERING

- Get all the facts
- Identify functions
- Model costs
- Identify constraints
- Orient team to scope
- Establish worth
- Make site visit

SELECT PROJECT FOR STUDY

See Chapter 24 for a sample workbook to be used by the team as the study continues

COST MODEL

Item Cost Worth Value Index and Functions

See Chapter 24 for a sample workbook to be used by the team as the study continues

The costs are shown graphically

FUNCTION ANALYSIS

FAST DIAGRAMS

See Chapter 24 for a sample workbook to be used by the team as the study continues

PHASE TWO: CREATIVE PHASE

See Chapter 24 for a sample workbook to be used by the team as the study continues

List new creative ideas per function area

CREATIVE BRAINSTORMING PURPOSE

To generate alternative methods for providing the needed functions by using creative thinking

Try to think of as many ideas that can accomplish the same function(s)

GOALS DURING BRAINSTORMING

- Do not judge the ideas
- Offer large quantity of ideas per function
- Break the item or function down and brainstorm ways to improve them

WARM UPS

It may be helpful for the group to work some mind teaser games before brainstorming to begin to see how one can think outside the box

It may be helpful to look at the item in a different manner

Establish the "rule" no idea is a bad idea

PEOPLE SKILLS DURING STUDIES

Exercise good people skills during the study realizing that everyone has a job to do

It is helpful to review the job plan with everyone before each phase

KEEPING THE TEAM ON TRACK

- Set clear objectives
- Encourage open discussions
- Use realistic timeframes
- Everyone can influence the outcome
- Realize conflicts may occur
- Conflicts can be positive as this will lead to a consensus
- Build confidence
- Enable team goals to be met

FACILITATOR RESPONSIBILITY

- Get decision made promptly
- Establish problem-solving techniques
- Suggest alternatives as needed
- Guide the team
- Document the results as the study continues
- Allow everyone to be heard
- Run the meeting according to the agenda
- Provide framework for a successful study

DO'S AND DON'T'S FOR MEETINGS

- Plan ahead
- Have meeting in a comfortable setting
- Make sure everyone has the material needed
- Use the job plan
- Get answers to questions
- Fully research backup for recommendations
- Assign duties
- Begin with the end in mind
- Present team recommendations after rehearsal

PHASE THREE: EVALUATION

- Review technique for evaluation of the ideas generated
- Be unbiased
- Include the decision makers
- Perform a midpoint review before further development

EVALUATION METHODS

Evaluation Matrix (see Chapter 24)
Other methods may be used such as:
-Choosing by Advantages
-Boston Squares
-Multivoting

Objective is to select the ideas that will work and have the greatest chances for value improvement and implementation

PHASE FOUR: DEVELOPMENT

- Provide a clear and concise recommendation
- Contrast the proposed concept by the VE team to the original concept
- Include advantages and disadvantages
- Attach sketches for proposed and original concepts
- Estimate the life cycle cost variances
    1. Include other variances
        -Attach an implementation action plan

DEVELOPMENT TIPS

- Anticipate roadblocks
- Motivate others to make the improvements
- Recommendations should sell themselves
- Advantages should outweigh disadvantages

PHASE FIVE: PRESENTATION

- Know your subject
- Explain the original problem
- Describe team's approach to solving the problem
- Be positive

PRESENTATION TIPS

- Know your audience
- Be prepared for questions
- Have a plan to implement the recommendations
- Put yourself in their shoes
- Limit the presentation to a few minutes per presenter

PRESENTATION TIPS

- Prepare, Prepare, Prepare
- Dry run the presentation
- Easy flowing presentation with visuals to explain the points
- Someone on the team play devil's advocate
- Everyone in the group support the recommendations
- Make eye contact and focus on the decision makers
- Face the audience

PRESENTATION TIPS

- Make sure the audience can see the material being presented
- Make no excuses
- Repeat questions when audience asks
- Summarize
- Get feedback from audience
- Document decisions made
- Outline steps and actions to be taken next

POST STUDY IMPLEMENTATION AND FOLLOW- UP

- Prepare a thorough plan
- Meet with the client to answer any questions after the presentation
- Follow up
- Avoid impacts to other schedules
- Assist to implement recommendations

FOLLOW ON STUDIES

Take another team or same team and review the same or similar projects in two years and build in improvements for future studies

Submit findings report

Determine lessons learned

VALUE ENGINEERING CHANGE PROPOSALS

Value studies
Improve the value and performance

Savings and improvements can be shared

Accommodates future plans
Reduces life cycle costs
Improves quality, time and operations for a facility

WHY IMPROVE VALUE?

- Focusing on function
- Following the job plan
- Starting early
- Analyzing life cycle costs
- Determining effects on schedules
- Developing implementable solutions

Last year FHWA obtained $1billion in value improvement by using this methodology nationwide

MODULE II: ADVANCED TRAINING SEMINAR INTRODUCTION

Started by Miles to find value improvement for General Electric in 1947

INTRODUCTION

An organized effort directed at analyzing the function of goods and services to achieve basic functions at the lowest overall cost, consistent with achieving the essential characteristics

NEED FOR VALUE IMPROVEMENT

- Cost improvement is a part-time job
- All products and services have unnecessary costs
- Improvements can be achieved on current designs
- Extends use of resources
- Creates change on purpose
- Provides a new skill for professionals

MANAGING PROJECT OBJECTIVES

Review the role of the facilitator in managing the project objectives and running a value study

LETTING THE JOB PLAN WORK

FACILITATORS ROLE DURING THE JOB PLAN

- INFORMATION: understand the scope
- FUNCTION ANALYSIS: analyze functions
- CREATIVITY: positive thinking
- EVALUATION: select ideas
- DEVELOPMENT: produce thorough recommendations
- PRESENTATION: present recommendations that are implementable

COST MODELING TIPS

- Determine an accurate depiction of the scope
- Determine where team will focus
- Compare estimated costs with parametric costs

PROJECT ANALYSIS

- Break the project or problem down by focusing on the functions
- Builds team work
- Focuses the team on item under study
- Everyone focused in the same direction
- Avoids coming up with solutions to the wrong problem

FAST DIAGRAMS

- Express functions in an active verb and measurable noun
- Ask HOW, WHY, and WHEN?
- Determine types of functions: Basic, secondary, required secondary, at the same time, all the time, one time, dependent, unwanted, etc.

CREATIVITY PROCESS

Facilitating teams to produce ideas not yet thought of that can accomplish same functions to desired level of design

Using the team's ability to produce ideas that breakthrough and improve the original design focusing on functions

TYPES OF FUNCTIONS

Take the time to understand the functions that are accomplished on the item under study

Success of the study depends on the analysis of functions

Challenge and test the FAST diagram

PROBLEM SOLVERS

- Understand the problem
- Take time to think of options
- Recognize that there may be more problem solving methods to be used

ADDING VALUE

As we begin to understand the opportunities for improvement search for ways to add value, not cut costs

VALUE MISMATCH

Value mismatch indicators are those that cost more than they are worth or those that may be worth more than they now cost

Other indicators are:
Few functions fulfilling basic need
Lots of function, but not many contributing to the overall objectives

Unbalanced effort to achieve needed functions

MANAGING TIME

While every study may focus on different items, the job plan can be used as an agenda to produce results that achieve intended objectives

Allow adequate time to complete the job plan phases, but remain cognizant of the areas to improve the time related functions on the item under study

FINANCIAL BREAKDOWN

Review the entire life cycle costs for the project under study

After this review the facilitator can identify the areas where additional focus should be given

A cost/benefit analysis of ideas generated can be reviewed with the team
Avoid only focusing on the initial costs

CONTRACTING METHODS/DECISIONS

Allow enough time for the team to review alternative methods available that may improve the contracting methods chosen for this study

Discussion takes place to improve the contracting methods and risk reduction factors associated with the contracting methods chosen or under consideration

LIFE CYCLE COST COMPONENTS

Each team member should take one of the life cycle cost problems and calculate the life cycle cost savings

Discussion on life cycle cost analysis of potential recommendation on a study takes place to indicate the team's decision may change after a full analysis of the total costs and not just initial or periodic costs

COST AND WORTH PER FUNCTION

Chose a new team leader to lead the team through the development of the problem shown in Chapter 39

Example: Bridge

Worth is the least cost to accomplish the same function to a desired level of quality

Function: _____

Cost: _____

Worth: _____

Value Index: _____

FINANCIALLY IMPORTANT DECISIONS

- A discussion on the effect of the value team's effort
- Analyzing a previous study
- Review the scope before the study
- Review the scope and value improvements to be made after the study

TEAM BUILDING SKILLS

- Discuss ways to improve the results of a study based on:
- Management's acceptance of recommendations
- Accomplishment of job plan goals
- Discuss your approach to producing best results

FUNCTION ANALYSIS DIAGRAMMING

Diagram the functions being analyzed for two similar projects. As stated in Chapter 42

- One project accomplishes the function by building a new interchange
- The second project accomplishes the function by modifying an existing interchange
- Which project is best and why?

ALTERNATIVE IDEAS

As stated in Chapter 43, the team leader may lead the group to generate creative ideas on either of the two problems shown.

- Improve travel by the year 2050
- Power generation alternatives to residences by the year 2020

Note time limit— ½ hour

Other topics may be chosen depending on the group. Discuss the ideas after listing them.

EVALUATING BEST ALTERNATIVES

As stated in Chapter 44, the team leader may lead the group to discuss ways to evaluate ideas generated for a roadway-widening or other project.

- Name seven major factors to be used in the matrix
- How would you rank the ideas

Discuss alternate evaluation methods that could be used.

DEVELOPMENT AND PRESENTATIONS FOR MANAGEMENT

As stated in Chapter 45, the team leader may lead the group to discuss ways to develop and present ideas generated for a roadway-widening or other similar project.

- Each team member should make a 5 minute presentation based on the team findings
- The team leader should prepare and present the teams work effort during the study followed by a summary of the presentation

VALUE PROGRAM ENHANCEMENTS

As stated in Chapter 46, a new team leader may lead the group to discuss ways to enhance:

- Establishing a new program within an existing mature value improvement program
- A mature value improvement program

SOLVING TECHNICAL PROBLEMS

As stated in Chapter 47, a new team leader may lead the group to develop a technically-oriented FAST diagram:

- Review the FAST diagram for the square versus round building column prepared by a contractor
- Draw your own FAST diagram for a similar item that would be on a value improvement study

BREAKING THE PROBLEM DOWN

As stated in Chapter 48, a new team leader may lead the group to develop a ladder of abstraction diagram to generate functions and possible ideas to improve each function.

CUSTOMER FOCUS

As stated in Chapter 49, a new team leader may lead the group to develop a customer-oriented diagram for one of the following.

- Airport concourse
- New interchange

LEADING A SESSION

As stated in Chapter 50, a new team leader may lead the group to develop a FAST diagram (choose your own type)

- Test the diagram
- Review from time perspective

DISCUSSION GROUPS

As stated in Chapter 51, a new team leader may lead the group to discuss ways to continually improve the value improvement study process

Discuss previous study successes and challenges

OVERALL COMPONENT ANALYSIS

As stated in Chapter 52, a new team leader may lead the group to study an overall program component, such as an interchange between two major highways, others may be used.

1. List four basic functions
2. List five secondary functions

SPECIFIC COMPONENT ANALYSIS

As stated in Chapter 53, a new team leader may lead the group to study a specific program component, such as a trail system, change order system, traffic signal, etc.

- Using the job plan perform a mini-study on the item chosen—1 hr time limit

SUMMARIZING STUDY RESULTS

As stated in Chapter 54, a new team leader may lead the group to discuss ways to simplify summarizing study results

Appendix B

Answers to Chapters 25, 38, and 55

CHAPTER 25: MIDTERM EXAM

1. Name the phases of the VE methodology used by the study team.

   Answer:

   Information gathering including function analysis, creativity, evaluation, development, and presentation/reporting.

2. What is the basic verb/noun function for your pencil or pen you are using to write? Can you also list one secondary function.

   Answer:

   Basic verb/noun function = make marks, a secondary function may look attractive.

3. Indicate the approximate cost of the basic function shown in number 2. Show the average total cost of the writing instrument; is it the same cost as the basic function? What is the basic function worth?

Answer:

If a pencil is being used the basic cost may five cents, and if you are using an ink pen the basic cost may be one dollar. The function of make marks is worth fifty cents (assumed).

4. Indicate an alternative for the writing instrument's basic function.

   Answer:

   An alternative may be the lead pencil in lieu of the ink pen to make marks.

5. What are the value indices for the writing instrument? Given VI = C/W, use the same cost and worth from number 3 and 4.

   Answer:

   If the pencil is being used the VI = 0.05/0.50 = 0.1, and if the ink pen were used the VI =1.0/0.5 = 2.0

6. One purpose of the FAST diagram is to understand the scope?

   Answer:

   Yes, but it serves other purposes such as identify and classifying the functions, and building teamwork.

7. Should a FAST diagram be developed for an item if all the functions are known?

   Answer:

   Yes, you may identify missing functions or functions that can occur in more optimum locations.

8. What are two questions to ask when developing a FAST diagram?

   Answer:

   Some of the questions asked are How, Why and When?

9. Indicate a function of the following components of a building.

   Door

   Carpet

   Window

Lights

Television

Answer:

Door = allow access

Carpet = cover surface

Window = view area and allow light

Lights = illuminate space

Television = monitor events and provide entertainment

10. Which of the items listed in number 9 would be considered a secondary function, if it were a fire station building?

Answer:

The carpet (cover surface)—the fire station may choose to use other materials to cover surface or paint the concrete surface.

11. Which is the most costly item, given the following:

Answer:

Concrete work	**200 cy x $500/cy =**	**100,000**
Trees	144 ea x $140/ea =	57,600
Paving	1500 sy x $15/sy =	22,500
Earthwork	1000 cy x $10/cy =	10,000
Doors	20 ea x $400/ea =	8,000

12. If the client would like to improve the items in number 11, which would be the first item to review, if the value index for earthwork is 1.3, paving is 1.1, doors is 1.0, concrete work is 1.33, and trees are 0.89? Given VI = C/W.

Answer:

Concrete work at 1.33 and then earthwork at 1.3.

13. Calculate the cost per square foot for items shown in number 11 (exclude the trees) if the total cost is $100,000 and total square feet for the building is 1,000.

Answer:

$100/sf.

14. What would occur first on a value study, creativity or function analysis?

Answer:

Function Analysis.

15. Which study would you prefer to be on if team A generated 15 ideas or team B generated 150 ideas?

Answer:

I would prefer to be on the team B. It has been proven that more successful studies result from larger quantities of ideas generated.

16. Would you consider the study a success if the client accepted 60% of the ideas presented, even though those were 20% of the total value of all ideas recommended?

Answer:

Yes, but the team should do the best job they can to get as many ideas accepted as possible.

17. If the disadvantages outweigh the advantages for a recommendation should the team make the recommendation?

Answer:

Usually the advantages for an idea presented should outweigh the disadvantages, but there be paramount reason why one idea should be implemented to improve the overall value.

18. If alternate one recommendation included an initial cost savings of $1 million, would that be better than another alternate with an initial added cost of $1 million, but had a present worth total life cycle cost savings of $2 million over 20 years?

Answer:

The client would probably accept the life cycle savings of $2 million even though the initial expenditure was higher.

19. The life cycle cost analysis is all that is needed to convince the owner of a better idea?

    Answer:

    The carpet (cover surface)—the fire station may choose to use other materials to cover surface or paint the concrete surface.

20. Should two ideas be developed even though the owner would not be able to accept both at the same time.

    Answer:

    Yes, the owner may want to convince others that one option is superior to the other and list reasons why it better.

21. Should the team leader allow one more idea to be developed one hour before the presentation of the major recommendations to the owner?

    Answer:

    The team may partially develop the idea and inform the owner that it could be an option to be considered. The team should remain focused on the major recommendations, especially one hour before the presentation.

22. Should the team develop an idea that violates a constraint, even though the team ranked it high in evaluation?

    Answer:

    The team may want to develop the recommendation to show that if the constraint could be modified the improvement could be _____. Some constraints cannot be modified, therefore the team would not need to waste time on that potential recommendation.

23. If the original items cost is $400,000 and the proposed value team recommendation is $400,000 would the team present the recommendation anyway?

    Answer:

    Yes, since there may be other advantages such as life cycle cost savings.

24. Determine the best value for using either stainless steel or carbon steel for a water storage tank, given that:

    Carbon steel costs $3/lb

    Stainless steel costs $5/lb

    Life of Carbon steel is 30 years Life for stainless steel is 50 years

    Owner expected life for the facility is 25 years

    Which would you recommend to the owner?

    Answer:

    The team may want to recommend the stainless steel option and the carbon steel option and let the decision-makers make their own conclusion. However, the facility may be better served by using a material (carbon steel) that is comparable.

25. What is the initial cost difference between carbon steel and stainless steel given that 100,000 lb of steel will needed to fabricate the carbon steel tank. Assume the stainless steel tank weighs the same as the carbon steel tank. Would you recommend the stainless steel tank even though the salvage value may be more than carbon steel?

    Answer:

    $200,000 cost difference. The team may choose to do a life cycle cost analysis on the comparison between the two material types. (See answer to 24).

TRUE OR FALSE

26. There is never time for VE.

    False

27. Value improvement is only used for complex engineering projects.

    False

28. More cost can be saved the earlier the value study is performed in design.

    True

29. Value programs are only used to correct design deficiencies.

    False

30. Aesthetic function does not count.

    False

31. Secondary functions do not need to be analyzed, only the basic functions need to be reviewed.

    False

32. Worth is the least cost to perform a function to a given set of parameters.

    True

33. An ideal team is a multidiscipline team with one or more members from each discipline.

    True

34. The value team should work on a study continuously for only 5 days.

    False, the time on the study may vary depending on the item under study. Some clients prefer to use this timeframe for a value analysis session.

35. The importance of the value study is the methodology approach, not the number of steps involved.

    True

36. It is best not to involve management until the value team has reached their conclusions.

    False

37. Brainstorming occurs first.

    False

38. Do not question the specifications if it is a government project.

    False

39. The team must agree on each idea submitted during the speculation phase.

    False

40. Team members should evaluate ideas during brainstorming.

    False

41. You should not question the constraints.

    False

42. Additional constraints can be found after the team makes a site visit.

    True

43. FAST diagrams are useful for breaking the problem into smaller pieces and determining if the functions are even necessary.

    True

44. A FAST diagram has a critical path.

    True

45. How, why, and when are three questions usually answered during FAST diagram preparation.

    True

46. The idea generation process should be separated from the evaluation phase.

    True

47. A group rather than the individual who created them should always evaluate ideas.

    True

48. The ideas should be viewed from the user or customer perspective.

    True

49. Use of a computer to evaluate the ideas is much better than a human.

    False

50. Value engineering programs can be called value analysis programs, as long as it produces the same systematic approach to problem solving and value improvement.

    True

51. Value programs should not be introduced during the construction phase of a project because it will cause delays and probably too many other changes.

    False

52. Life cycle costing should always be included in the analysis because the owner may not only want initial cost savings.

True

53. Value engineering programs are just for cost reduction.

False

54. Adding value is one thing the team should try to do.

True

55. The team cannot proceed if they do not receive the information before the study begins.

False

56. The team leader might choose to adjust the agenda after the first day's meeting and decide to finish one hour later than scheduled.

True

57. The value team can verify the original cost estimate during information gathering.

True

58. A cost/worth model can be used as an indicator to determine where the team might focus their efforts.

True

59. The manager receiving the value study should direct the original engineering team to implement the value study recommendations.

False, the engineering team may want to review the results and make recommendations to the manager. Qualify your answer

60. The value study should provide an implementation plan.

True

61. There is less risk implementing certain ideas.

True

62. After a well-done oral presentation the team does not need to submit a written report.

False

63. Value improvements can become an organizational behavior.

True

64. No matter what the value team determines the customer must live with it.

True

65. The lowest life cycle cost is the best value.

Qualify your answer, False

66. Constructability and ease of maintenance can be used as two of the many evaluation criteria that may be used when comparing two competing alternatives.

True

67. It is a good practice to convert the total X year life cycle cost savings to a present worth of the life cycle cost savings.

True

68. Do not select a project for a value study if it is not a good candidate for potential savings.

False, the project may have other areas needing improvement

69. If the item under study has good value already then the team should not pursue it.

False, see above

70. Secondary function may have the highest costs.

True

71. Do not question city codes.

False

72. During the creative phase you should try to generate the greatest number of ideas.

True

73. Habits, lack of time, wrong information, customs, and culture can be causes of unnecessary costs.

True

74. Do not judge ideas offered during the speculative phase.

True

75. Value engineering or analysis (VE/VA) is only as effective as an engineering discipline.

False

76. The value, once determined, does not change.

False

77. Value improvements are difficult to apply to new designs.

False

78. Standard designs do not require value improvement.

False

79. Worth is the lowest total cost of a product.

False

80. Pareto's Law says that 20% of the items do not need to be studied.

False

81. One basic function of a pipeline is to transport fluids.

True

82. If the product now has a longer service life after the VE study then we have better value.

True

83. Value teams should not question the general conditions of the specifications.

False

84. Performance can improve while cost is reduced.

True

85. Maintaining good human relations is considered crucial to the success of a value improvement study.

True

86. Value studies are not required for projects that are on schedule and within budget.

False

ANSWER THE FOLLOWING QUESTIONS:

87. What is a basic function of an elevator? Could that function be studied?

Answer: Transport goods/people, yes

88. What is one of the items to be covered on the value study agenda?

Answer: Cover the items needed by the job plan

89. Assume one of the basic functions of a $70 million hospital is to treat patients. If the left scope line on the FAST diagram moved one function to the right would the scope of the value study change?

Answer: Yes

90. If the value index for HVAC is 0.79 how much is HVAC worth per ton if there is 185 ton costing $204,000? Assume VI = C/W.

Answer: $1,395.83/ton

91. If a cost to cover a surface of the wall varies from one material to another would you choose the one that is best value or looks better?

Answer: Best value may include the appealing aesthetics

92. How would you fix project A if it is 35% over budget, 9 months behind schedule, and the project is supposed to start construction in six months?

Answer: Use the value methodology

CHAPTER 38: LIFE CYCLE COST COMPONENTS

1. The DOT is considering two proposals for a bridge replacement project. One alternative is a steel girder structure. The other is a concrete beam structure. Using the information below determine which structure is the most cost effective. Both structures have a 50-year life. Use a discount rate of 7% and perform an alternative analysis using 4%.

   Steel Alternative

Initial Cost =	$10,000,000
Annual Maintenance =	$45,700
Rehabilitation (year 25)=	$125,000
Salvage Value =	($1,000,000)

   Concrete Alternative

Initial Cost =	$10,100,000
Annual Maintenance (year 1– 25) =	$55,700
Annual Maintenance (year 26–50) =	$62,500
Rehabilitation Cost (year 15) =	$60,000
Salvage Value =	negligible

   Determine the most economical solution.
   Answer: Steel alternate in each case

2. The state is considering two proposals for a process improvement project. One alternative is to continue using the existing process to produce_____. The other alternative is to use the value team's recommendation using a streamlined process to produce _____. Using the information below determine which alternative is the most cost effective. The process has a 25-year life. Use a discount rate of 4% to perform an alternative analysis.

   Existing Process

Initial Cost =	$4,000,000
Annual Maintenance =	$500,000
Reconfiguration Cost (year 5) =	$100,000
Salvage Value =	none

Alternative Process

Initial Cost =	$5,000,000
Annual Maintenance =	$100,000
Reconfiguration Cost (year 5) =	$50,000
Salvage Value =	$100,000

Determine the most economical solution. Determine the most economical solution using the team's own assumptions.

Answer: Alternate process by $7.9 million using 3% escalation

3. The financial institution is considering two proposals for a process/product improvement project. One alternative is to continue using process/product A to produce_____. The other alternative is to use the value team's recommendation to use process/product B to produce _____ for its customers. Using the information below determine which alternative is the most cost effective. The process/product has a 5-year life. Use a discount rate of 3% to perform an alternative analysis.

Process/Product A

Initial Cost =	$700,000
Annual Maintenance =	$50,000
Interim Cost (year 2) =	$55,000
Salvage Value =	none

Process/Product B

Initial Cost =	$550,000
Annual Maintenance =	$10,000
Interim Cost (year 3) =	$5,000
Salvage Value =	$1,000

Determine the most economical solution.

Answer: Alternate Process/Product B, by $381,000

4. The manufacturer is considering three proposals for a program improvement project. One alternative is to continue using the following assumptions to produce_____. The other two alternatives use the value team's recommendation using the following assumptions to adjust the program produce _____. Using the information below determine which alternative is the most cost ef-

fective. The process has a 10-year life. Use a discount rate of 5% to perform an alternative analysis.

Existing Program

Initial Cost =	$14,500,000
Annual Maintenance and Operation =	$300,000
Program upgrade Cost (years 1 and 5) =	$250,000
Salvage Value =	$1,000,000

Program Alternative Two

Initial Cost =	$16,000,000
Annual Maintenance and Operation =	$1,000,000
Program Adjustments (years 5 and 7) =	$15,000
Salvage Value =	$2,000,000

Program Alternative Three

Initial Cost =	$21,000,000
Annual Maintenance and Operation =	$200,000
Program Adjustments (year 3)	$50,000
Salvage Value =	$5,000,000

Determine the most economical solution(s). The team may change the assumptions based on their variables/parameters.

Answer: Existing program as is.

5. The builder is considering three options for a technique improvement for the labor portion of the project. The original case shown below is to continue using the existing labor methods to produce_____. The other two alternatives use the value team's recommendation using the following assumptions to potentially improve the labor methods to produce _____. Using the information below determine which alternative is the most cost effective. The labor method has a 4-year life. Use a discount rate of 7% to perform an alternative analysis.

Existing Labor Method

Initial Cost =	$500,000
Annual Support Labor =	$13,000
Adjustments (years 1 and 2) =	($5,900)
Salvage Value =	2%

Labor Method Alternative Two

Initial Cost =	$450,000
Annual Support Labor =	$11,000
Adjustments (years 1 and 3)	$5,000
Salvage Value =	2%

Labor Method Alternative Three

Initial Cost =	$760,900
Annual Support Labor =	$2,000
Adjustments (year 1) =	$2,000
Salvage Value =	5%

Determine the most economical solution(s). The team based on given parameters may change the assumptions.

Answer: Labor method alternate two

6. The producer is considering three proposals for an operational improvement project. One alternative is to continue using the following assumptions to produce_____. The other two alternatives use the value team's recommendation using the following assumptions to adjust the operation to produce _____. Using the information below determine which alternative is the most cost effective. The process has a 6-year life. Use a discount rate of 4% to perform an alternative analysis.

Existing Operation

Initial Cost =	$4,769,450
Annual Maintenance and Operation =	$89,100
Upgrade Cost (each year) =	$56,000
Salvage Value =	10%

Operational Alternative Two

Initial Cost =	$550,989
Annual Maintenance and Operation =	$99,100
Upgrade Cost (year 4) =	$55,000
Salvage Value =	20%

Operation Alternative Three

Initial Cost =	$670,122
Annual Maintenance and Operation =	$100,000

Operation Change (year 5) =	$400,000
Salvage Value =	34%

Determine the most economical solution(s). The team based on given parameters may change the assumptions.

Answer: Operational alternative two

CHAPTER 55: EXAM REVIEW

ANSWER THE FOLLOWING QUESTIONS:

1. The team leader should prepare the plan, draft an agenda, identify information needed by the team, and prepare a budget during a pre-study phase.
   Answer: True
2. The team leader helps the owner determine who should be on the team.
   Answer: True
3. The team leader should make sure that everyone attending the study has signed the sign-in sheet.
   Answer: True
4. Ideas can be generated by brainstorming on each function taken from the FAST diagram.
   Answer: True
5. The job plan will not work without the team leaders involvement.
   Answer: True
6. Constraints are determined early in the job plan.
   Answer: True
7. A FAST diagram can be cost loaded.
   Answer: True
8. The term "value," as it relates to the field of value improvement is determined by: (circle correct letter)
   a. The manufacturer
   b. The buyer
   c. The seller
   d. The value engineer
   e. The design engineer
9. The team should adjust the cost estimate upwards if the team determines that items of scope are not included in the original estimates.
   Answer: True

10. Parametric costs may be used to compare to the original cost estimate to determine the worth and determine if the estimate may be high or low in some areas compared to historical parameters.
Answer: True

11. If one cost estimate item contains 50% of the cost of the total items cost of the item is always a basic function.
Answer: False

12. What is most important to the success of a value study?
a. Discovering the most economical solution
b. Maintaining good human relations
c. Proving that value needs to be improved
d. Developing a solution that is easily implementable

13. Select the true statements:
a. Value engineering should not be applied during construction or operation because of the cost of making changes or the possible delay in schedule
b. An important reason to do a VE study is to identify and correct design deficiencies
c. All architects and engineers perform value, therefore no specific contractual clauses are needed in design contracts
d. Value studies are needed on projects that are within the budget and on schedule

14. What are the functions of a cost model in the value study process? List at least three.
Answer: Identify areas of potential opportunity for improvement, determine missing scope, determine scope of the item under study

15. Are any items in the FAST diagram shown below out of order? If so, please draw the functions as they should be shown.

Present Recommendations	Develop Alternatives	Evaluate Alternatives	Create Ideas	Gather Information

Answer: No

16. If the basic function of an elevator is to carry goods/people. What is an answer when we ask "why does the elevator carry goods/people?"
Answer: To increase productivity.

17. Given: there are two types of FAST diagrams: technically-oriented and customer-oriented. Development of each diagram can identify the basic function and critical path functions.
Answer: Yes

18. A FAST diagram can help the team identify duplicate functions?
Answer: Yes

19. Everyone has some creative ability. All ideas should be documented as they are submitted during the creative phase.
Answer: Yes both parts

20. A person caught judging another person's idea is not allowed during creativity phases.
Answer: No, it should be judged in the evaluation phase

21. Would it be a good investment to spend $10,000 in conducting a value study and redesigning the project per the items listed in the cost model below. State your answer and reason for it.
Answer: Yes, if the team recommended a 10% improvement, then the return on study cost investment would have been 30 to 1 although the team had targeted a 30% potential improvement (note the total cost/sf / total worth/sf)

Cost Model

Office building — 50,000 gross square feet (sf)

ITEM	Cost	Worth	
Basic bldg.		47.12/sf	35.80/sf
Site work		4.91	4.00
Gen. & spec			
Conditions		6.42	6.00
Structural		4.64	4.75
Foundation		2.91	2.50
Structural		1.73	2.25
Architectural		14.95	9.25
Ext. wall and roof		9.59	5.00
Int. const.		3.29	2.50
Int. finishes		2.07	1.75
Mechanical		10.98	7.80
Electrical		5.22	4.00

22. What is the value index for plumbing if each fixture is worth $675? (99 fixtures, cost = $83,500)
Answer: VI = C/W 843/675 = 1.25

23. If the value index for HVAC is 0.79, how much is HVAC worth per ton? (cost = $204,000, 13 ton)
Answer: VI = C/W 204,000/13 = 15,692/ton, VI = C/W, 0.79 =15,692/W = 19,864/ton

24. If a concrete sidewalk costs $3.50 per square yard and grassing costs $1.50/sy , is the open paving on this project good value? (assume: open paving [parking, roads], $25,214 for 98,100/sf).
Answer: assuming that all three items have same function to cover surfaces, then, the best value would be grassing, except it may have more maintenance in the future, depending on the application.

25. Value study programs should be enhanced when management is supportive of the program.
Answer: Yes, especially need to provide continuous improvements to the program.