

Value Engineering Fundamentals - Project Scope & Budget  
*Construction Oriented*

Value Engineering Training Course  
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## Course Introduction

This course is designed for people responsible for making significant decisions concerning budgets for large, complex construction projects in private industry and public institutions. Such as, project executives, managers, architects, engineers, purchasing professionals, trainers and technical specialists in construction, and manufacturing.

Students learn fundamental concepts of Value Analysis with a greater emphasis on Project Scope & Budget.

## Knowledge and Skills

- Understand the fundamental concepts of Value Analysis
- Understand the information needed to develop a Project Initiation
- Understand the information needed to develop a Project Charter
- Understand the information needed to develop a Project Scope
- Understand the information needed to develop a Project Budget
- Define Cost/ Scope/ Schedule/ Quality (CSSQ)
- Develop the ability to determine indicators of the required functions and the worth of a project
- Understand Economic Factors
- Understand Cost Modeling
- Understand Energy Modeling

## Key Words and Definitions:

Cost	Project Plan
Cost Approach	Project Scope
Cost Model	Rate of interest
CSSQ	Teamwork
Economic Factors	VA Study Elements
Energy Modeling	Value
Function	Value Analysis
Life Cycle Costing	Value Engineering
Project Budget	Value Management
Project Charter	Workshop Phases
Project Initiation	Worth

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## VALUE ANALYSIS OVERVIEW

### GENERAL

Value Analysis is synonymous, with the terms Value Engineering, and Value Management.

Value Analysis (VA) is a creative, organized approach with the objective of optimizing life cycle costs and of the performance of a system, facility, or building. Value is defined in four kinds; use, exchange, cost and esteem. The construction industry has seen significant cost increases-remember doubling of construction costs from 1970 to 1980; materials price increases (with little subsequent reduction) from Hurricane Andrew in Florida and parts of the South; current escalating labor and material costs. Owners and Designers were left with little choice but to increase budgets for new construction to accommodate these trends. The cost of the construction basics rose reducing discretionary expenditures. All of this against a backdrop of the impact of the loss of cheap, affordable energy during the “energy crisis” from 1975. Value Analysis offers project stakeholders an opportunity to maximize the most important elements of a project while evaluating value, lessening project life-cycle costs, addressing financial issues, and reducing waste and or unnecessary costs.

A key element in the procedures is the use of a multi-disciplined team to analyze the project utilizing Value Analysis methods. It is the team’s objective to use the VA methodology to evaluate the project to find instances of poor value and high costs, recommend alternatives, and estimate initial and life-cycle costs whenever significant for the original system and for all proposed alternate systems (or components, practices, etc.). Other criteria are also used to assure the proposed recommendations did not sacrifice essential project quality and functions and timely project completion. All activities are based on improving value, which is defined to be the sum of performance and quality divided by cost.

## I. PRE-STUDY PREPARATION

The Value Analysis effort produces the best results when each party to the study has a clear understanding of how and why a VA study is conducted. Also, a clear understanding is required of the input needed from the Owner, Designer, Construction manager, and the VA study team. Whenever possible, a coordination meeting is held before the VA study effort to coordinate schedules and to outline information needed from project team members to perform the study. On large projects (greater than \$10,000,000) VA team members must study the project background material prior to the workshop session.

Coordination with the design team prior to the study allows the VA team members to review all available information including engineering studies and reports; final design concepts, calculations, and specifications; important correspondence; cost data; design criteria; regulatory constraints or influences; and scheduling for the project. It is advisable that each team member documents a list of first ideas and questions requiring Owner/Designer responses.

When evaluating an existing facility or proposed site, a site visit is extremely valuable and should be done by selected VA team members, as appropriate to the specific study. Existing facilities are observed and an assessment of the surrounding local area for the impact of the proposed project is made. The site visit offers an excellent opportunity to assess operating conditions, costs of current systems or facilities, site layout, construction issues and site usage concerns.

### Economic Factors

During the Value Analysis study, construction cost and life cycle cost summaries are performed on elements of the project having significant follow-on cost impact. Often cost comparisons between planned and proposed alternatives are made on a present worth basis. The selection of such important economic factors such as life-cycle duration (years), and interest rate need to be agreed upon at this time.

### Cost Data

Cost information for the Value Analysis study is typically prepared by the design firm and validated by the VA team. Increasingly, as Construction Managers are involved they prepare the project cost estimates. This information needs to be as detailed and descriptive as possible and becomes the foundation for the entire Value Analysis study effort function analyses. The cost data should be presented to the Value Analysis team members in advance of the actual workshop effort. Project designers or CM presents cost data to the team on the first day of the actual workshop with accompanying justification and methodology. In practice it has been found that cost validation efforts by the VA team are quite worthwhile and have greatly improved subsequent cost-based decisions.

### Cost Modeling

The VA team then analyzes the costs and distributes the cost data in a cost model by project components (structures, processes, construction element, materials, schedule, etc.) as appropriate for the purpose of the study. The cost estimate and cost model reflect current costs. The cost model assists the VA team in identifying areas of potential savings and to proportion costs by function. It is absolutely imperative that this cost model be accurate and descriptive of the entire project as it is the economic basis of all further VA work. Costs, quantities, unit costs, and all other economic factors must be accurate and appropriate to the project under study.

Target costs are derived from historical data; experience of the VA team members'; and application of functional cost/worth determinations within the VA study methodology.

### Energy Modeling

Whenever it is deemed significant, an energy usage model is also prepared for large projects prior to the VA workshop. On smaller projects the energy model is prepared as part of the workshop activities. The energy model brings together information relating to the consumption of electric energy, fuel oil, natural gas, and from other sources. Energy model data is typically taken from information contained in the contract specifications and plans or from design stu

The energy model shows plant processes or project components by their intended use of energy by amount and type. All connected motors are to be evaluated based on operating time, horsepower draw, and number of units operating. Fuel requirements are included for other equipment. Total energy costs are then derived from estimated usage applied to appropriate energy unit costs. Note several common units shown below; also note that these costs vary in time, region, locale, industry, and other factors:

Electrical Power                      \$ 0.08/KWH\*

Natural Gas                              \$ 0.50/Therm\*

Diesel Fuel                                \$ 1.42/Gallon\*

\*            Use current and local appropriate costs

#### Life Cycle Cost Modeling

A life cycle cost model is prepared for the project under study by combining the information in both the cost and energy models and including other related costs such as staffing, security, overhead, etc., to develop life cycle costs. These costs are prepared using the techniques of engineering economy. It is very important that there be agreement with the Owner as to the specific economic factors used in this analysis such as interest rate, expected life of the project, and on projected staffing and related follow-on costs. Life cycle costs include all economic aspects of developing, designing, constructing, operating and maintaining the facility over its intended life span.

## II. VA WORKSHOP PHASE

During the actual workshop portion of the VA study, the Job Plan is followed. The Job Plan is an organized approach for searching out the instances of poor value or high costs in the design (or existing facilities) and developing alternatives for consideration. The workshop session uses a multidiscipline team following the Job Plan to arrive ultimately at recommendations for implementation.

The Job Plan follows five (5) key steps or phases:

- \* Information Phase

- \* Creative Phase

- \* Judgement Phase

- \* Development Phase

- \* Recommendation Phase

### Information Phase

At the beginning of the VA study it is important to understand the background and decisions that have influenced the development of the project design. Because of this, the Owner and Designer present an oral overview of the design. This presentation usually includes: the history of the project; the rationale for the design; project constraints; site conditions; factors influencing decision making; and the reasons for selecting the process equipment or major materials or systems for the project. Also, project costs and schedule data are discussed. Subsequently, each team member familiarizes himself with the project documents. The information phase also includes preparation of the cost and energy models from cost data assembled before the workshop began. These models are updated based on information received during the Designer's presentation. The VA team then reorganizes the cost data if appropriate and then sets target savings based on in-depth group (VA team members) functionally oriented discussions.

The next step in the information phase is to perform the function analysis. The functions of the system/project are the controlling elements in the overall VA

approach. The procedures used in the Information Phase are vital to the VA team because it forces the team to think in terms of functions and the costs related to each of the functions. Preparing the function analysis helps to generate many of the ideas that eventually result in recommendations for project improvement and/or cost savings. To attempt to isolate the high cost areas, the project is analyzed with cost/worth ratios developed by the VA team. The higher the cost/worth ratio, the greater the potential for discovering and developing cost savings. Worth is applied based on the premise of finding the least cost to provide the required functions. This forces the VA team to speculate on alternative solutions to the proposed design.

### Creative Phase

This phase of the VA process involves the generation and listing of creative ideas. During this time, the VA team thinks of as many ways as possible to provide the necessary functions within the project. The creative idea listing for the team(s) and notes from discussions among the VA team members and coordinator/leader are included in the VA workshop report. Separate teams typically have separate creative phase report sections. During the creative phase, judgment of the ideas being developed is restricted, and ideally is not present at all. The VA team is looking for the greatest quantity of ideas, which will subsequently be screened, in the next phase of the study. This issue is one of the most challenging for VA team members and participants. Many of the ideas brought forth in the creative phase are a result of work done in the function analysis and prestudy efforts.

### Judgment Phase

In this phase of the workshop, the VA team judges the ideas developed during the creative phase. The VA team ranks the ideas. Ideas found to be irrelevant or not worthy of additional study are disregarded; those ideas that represent the greatest potential for cost savings and improvements are selected for development. A weighted evaluation is applied in some cases to account for project impacts other than costs (both capital and life cycle). Ideally, the VA team would like to evaluate all attractive ideas but time constraints often limit the number of ideas that can be developed during the workshop. As a result, the team focuses on the higher ranked ideas. This phase is designed so that the most significant ideas are isolated and prioritized.

### Development Phase

During the development phase of the VA study each designated idea is expanded into a workable solution. The development consists of the recommended design, capital and life cycle cost comparisons and a descriptive evaluation of the advantages and disadvantages of the proposed recommendations. It is important that the VA team be able to communicate the concepts for their recommendation(s) to the workshop audience, for if the proposal is not understood it will not likely be accepted. Therefore, each recommendation is presented with a brief narrative to compare the original design to the proposed change. Sketches and design calculations, where appropriate, are also presented.

### Recommendation Phase

The last phase of the VA study is the presentation of recommendations. The VA recommendations are typically screened by all VA members before presentation to the workshop personnel. That audience typically consists of the Owner/User, Designer, Regulatory staff, and increasingly the Construction Manager and sometimes the public. Final recommendations are presented orally during the workshop.

The VA team leader and/or team members describe the recommendations and the rationale that went into the development of each proposal. Value engineering worksheets and a summary of the VA results are given to the Owner or Designer at this time in draft format. This begins the evaluation by the Owner and the Designer of the VA report recommendations.

### III. POST-STUDY PROCEDURES

The post-study portion of a VA study includes preparation of the Value Analysis Report incorporating the recommendations developed during the workshop. The Designer then responds by accepting and incorporating the proposals into the project design, rejecting the proposals, or recommending further study. Usually the Designer puts these decisions in writing to the Owner as a VA Report addendum with justification for proposal responses. A summary of the cost savings resulting from the study and the required redesign costs are also included in the Designer's response. There follows a final report and VA study closure after the Owner and Designer have responded to the draft recommendations and these comments are addressed and included in the VA final report. The final VA report is then prepared in finished form by the VA team and subsequently submitted to the Owner.

## **PROJECT SCOPE & BUDGET OVERVIEW**

The development of the Project Scope & Budget used in the Value Analysis begins, with the Project Initiation phase.

### **Project Initiation**

#### **Purpose**

The purpose of Project Initiation is to begin to define the over-all parameters of a project and establish the appropriate project management and quality environment required to complete the project.

Development of the Project Charter is a pivotal starting point for the project, establishing the project definition that will serve as the foundation for all future efforts. The completion of this process is marked by the Project Kick-off Meeting, in which the Project Manager presents the Project Charter.

Successful projects begin with a detailed project definition that is understood and accepted by Stakeholders. Putting everything down in writing helps ensure a commitment among Project Team members and between the team and the Stakeholders. As part of Project Initiation, an initial Project Plan is developed, which comprises the Project Charter, Cost/ Scope/ Schedule/ Quality (CSSQ) documents, and preliminary risk identification list.

These documents, once approved, ensure a consistent understanding of the project, help to set expectations, and identify resources necessary to move the project to the next level of detailed planning. Potential problems are identified so that they can be addressed early in the project.

Also during Project Initiation, a high-level Project Schedule is developed as the roadmap to more detailed Project Planning and Project Execution and Control. This high-level schedule will be refined over time, and will serve as the primary source of information regarding project status and progress. An accurate, realistic, and complete schedule, rigorously maintained, is essential to the success of a project.

Sponsorship of the project must be confirmed or gained during Project Initiation. Having a Project Sponsor, and securing approval early in the project management lifecycle, helps to ensure a commitment to the project.

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<sup>2</sup> New York State, Office for Technology (OFT), Project Management Guidebook, Section I: 2 Project Initiation

## List of Processes for Project Initiation

The Project Initiation consists of the following processes:

1. Prepare for the Project, where the Project Sponsor and initial Project Team are identified and work with the Project Manager to create the Project Charter.
2. Define Cost/ Scope/ Schedule/ Quality (CSSQ), where the Project Manager, along with the Project Team define the scope of the project and identify the preliminary budget, high-level schedule and quality standards to complete the project.
3. Perform Risk Identification, where the Project Manager and Project Team begin to identify and document any risks associated with the project.
4. Develop Initial Project Plan, where the Project Manager and Project Team identify all Stakeholders and document their involvement in the project, develop means of communicating with them, and compile all documentation created during Project Initiation to produce the Initial Project Plan.
5. Confirm Approval to Proceed to Next Phase, where the Project Manager reviews and refines the Business Case, secures resources required for Project Planning and prepares the formal acceptance package for review and approval by the Project Sponsor.

## List of Roles

The following roles are involved in carrying out the processes of this phase.

Project Manager

Project Sponsor

Project Team Members

Customer

Customer Representatives

Stakeholders

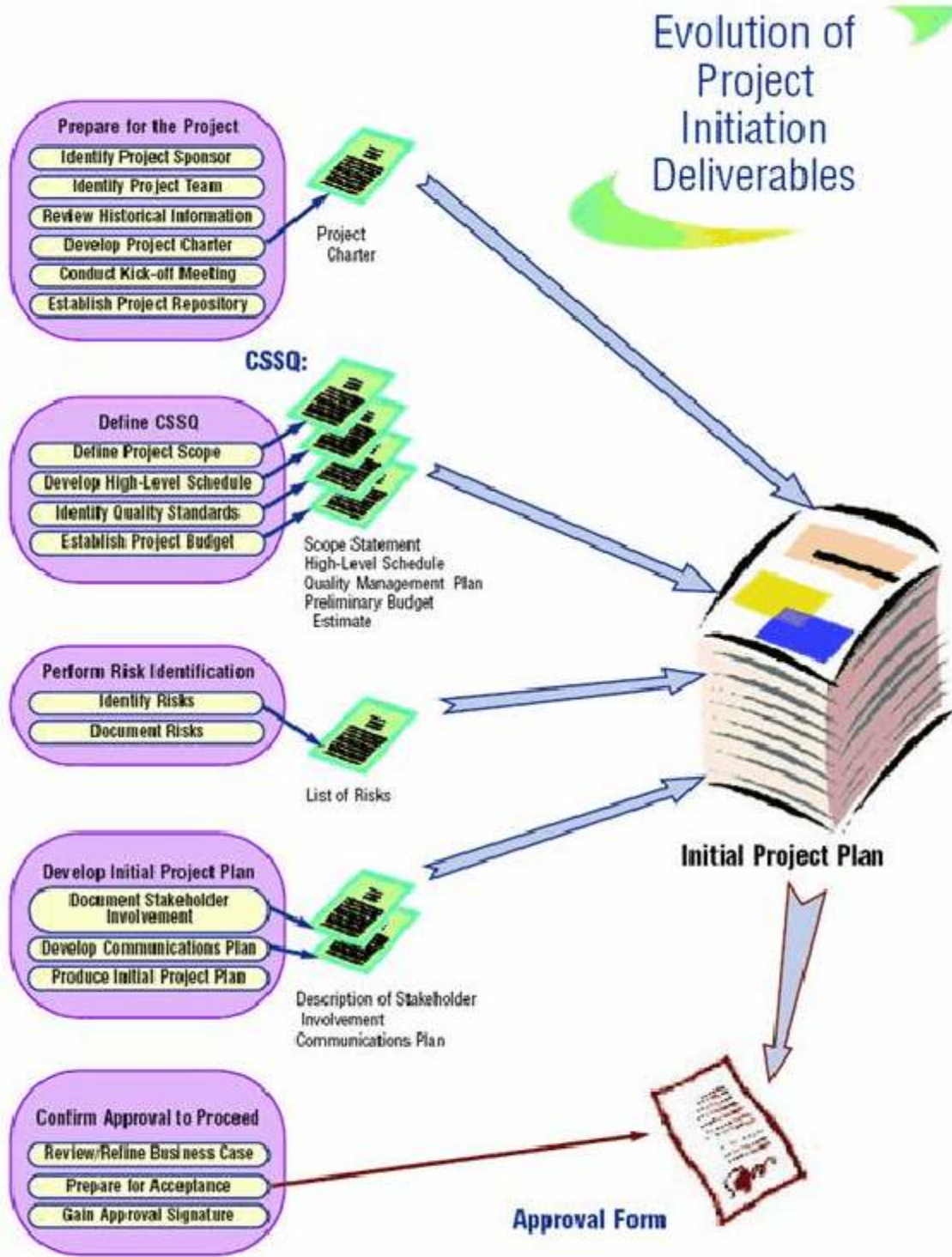
Performing Organization

Figure 1 below illustrates all of the processes and deliverables of the Project Initiation.

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<sup>2</sup> New York State, Office for Technology (OFT), Project Management Guidebook, Section I: 2 Project Initiation

Figure 1 Process and Deliverables



<sup>2</sup> New York State, Office for Technology (OFT), Project Management Guidebook, Section I: 2 Project Initiation  
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## <sup>s</sup>List of Deliverables

Project deliverables for the Project Initiation fall into three categories of importance and formality:

1. Phase deliverables – major deliverables approved by the Project Sponsor or a designated alternate that allows the project to proceed to the next phase.
2. Process deliverables – drafts of major deliverables or minor deliverables that may or may not require a formal sign-off but nevertheless must be reviewed by Project Team members, Customer Decision-Makers, and the Project Sponsor. The review validates the project's progress, and allows the Project Manager to move on to the next process in confidence.
2. Task deliverables – drafts of process deliverables or works-in-progress that are verified within the Project Team, and may or may not be reviewed by the Project Sponsor or Customer Representatives. Each task culminates with the production of one or more tangible deliverables, which allows the Project Manager to monitor project progress using concrete and real results.

Figure 2 lists all Project Initiation tasks and their outcomes and deliverables.

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<sup>2</sup> New York State, Office for Technology (OFT), Project Management Guidebook, Section I: 2 Project Initiation

Figure 2- List of Deliverables



<sup>2</sup> New York State, Office for Technology (OFT), Project Management Guidebook, Section I: 2 Project Initiation  
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## <sup>s</sup>THE PROJECT CHARTER

The purpose of developing the Project Charter is to document critical success factors and define and secure commitment for the resources required to complete Project Initiation. The charter also documents the project's mission, history, and background, describes the business problem the project is intended to resolve, and lists the benefits to be realized by the Performing Organization as a result of implementing the service.

Information compiled during Project Origination is used and applied in the development of the Project Charter. To further understand how the project was selected and to write an effective, comprehensive charter, the Project Manager must work with the Project Sponsor and any appropriate subject matter experts and Stakeholders.

If issues or conflicting project expectations are uncovered while developing the Project Charter, the Project Manager must communicate with Stakeholders to resolve the discrepancies, elevate the issues when appropriate, and obtain consensus.

Decisions that impact project expectations significantly should be thoroughly documented.

The Project Charter contains the following sections:

- \$ Background
- \$ Objective
- \$ Critical Success Factors
- \$ Required Resources
- \$ Constraints
- \$ Authority

Developing the Project Charter is a collaborative effort. Working with the Project Sponsor, the Project Manager should document the outcomes that must be achieved in order for the project to be considered a success. These critical success factors should correlate with the goals and objectives of the project.

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<sup>2</sup> New York State, Office for Technology (OFT), Project Management Guidebook, Section I: 2 Project Initiation

## Developing A Written Project Scope Statement

### Defining CSSQ

#### Purpose

CSSQ is the acronym derived from a project's quadruple constraints: Cost, Scope, Schedule, and Quality. Because the constraints are interdependent, they are defined and managed together. The CSSQ concept is incorporated throughout all project management lifecycle phases. The CSSQ work products are first created during Project Initiation.

The purpose of Defining CSSQ is to:

1. Develop a written Project Scope statement to define the project. The scope statement will be used as the foundation for scope and schedule refinement during Project Planning.
2. Establish a preliminary Project Schedule to define, at a very high level, the activities that must be accomplished at certain points in the project in order to deliver the service described in the scope statement.
3. Define the quality processes and standards that will be used throughout the project.
4. Determine the appropriate approaches for staff and materials acquisition, and establish a preliminary budget for the project.

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<sup>2</sup> New York State, Office for Technology (OFT), Project Management Guidebook, Section I: 2 Project Initiation

## Defining Project Scope

The written scope statement is a document that serves as input to future project planning efforts.

The scope statement should include:

- \$ the business need the project will address.
- \$ what the project will accomplish, how it will be accomplished and by whom.
- \$ what the end result of the project will be (e.g., a service, other).
- \$ a list of project deliverables, which, when produced and accepted, indicate project completion. Also included is a list of those items/deliverables that are not in scope for the project. The Project Manager must be specific about what is in scope and what is not in scope, as the weaker the boundaries between the two, the more difficult it will be to effect the change control process if required later in the project. Also, the details regarding what is in and what is out of scope are critical input to the creation of a detailed Project Schedule.
- \$ critical success factors (usually cost, schedule, and quality measurements) that determine whether or not a project was successful. The Project Charter, including the project outcome description, provides necessary information for defining the Project Scope relative to the business need and benefit for the organization undertaking the project. The scope statement will build on the outcome of the project described in the Project Charter by developing an approach to deliver that result, and by developing additional detailed information about the scope of work to be done. Interviews with other Project Managers who have had experience developing scope

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<sup>2</sup> New York State, Office for Technology (OFT), Project Management Guidebook, Section I: 2 Project Initiation

## °Establishing The Project Budget

Using available tools, the Project Manager calculates the preliminary budget that will be required to complete project activities.

All aspects of the project, including the cost of human resources, equipment, travel, materials and supplies, should be incorporated.

At this point information will be presented at a summary level, to be refined during Project Planning, as more detailed information becomes known. However, the budget should be more detailed and more accurate now than it was during Project Origination.

The Project Manager should use manual or automated tools to generate a Preliminary Budget Estimate. The budgeting tools may be simple spreadsheets or complex mathematical modeling tools.

For historical purposes, and to enable the budget to be refined, the Project Manager should always maintain notes on how this preliminary budget was derived. Cost estimating checklists help to ensure that all preliminary budgeting information is known and all bases are covered.

The Project Manager must also have a general understanding of the cost of both the human resources and the equipment and materials required to perform the work. The method by which staff and products will be acquired for the project will directly affect the budgeting process.

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<sup>2</sup> New York State, Office for Technology (OFT), Project Management Guidebook, Section I: 2 Project Initiation

## HOMEWORK

1. Which one is not an Objective of Value Analysis?

Reduce costs \_\_\_\_\_

Reduce time \_\_\_\_\_

Reduce quality \_\_\_\_\_

Improve Reliability & performance \_\_\_\_\_

Improve attitudes \_\_\_\_\_

2. Fill-in-the blank definition as used in VA from one of the following words:

Value, Value Analysis, Life Cycle Costing, Function, Cost, Worth.

There are four kinds of value cost that, use esteem and exchange.

\_\_\_\_\_

3. Fill-in-the blank definition as used in VA from one of the following words:

Value, Value Analysis, Life Cycle Costing, Function, Cost, Worth.

\_\_\_\_\_ is a rigorous, systematic effort to improve value and optimize the life cycle costs of a facility.

\_\_\_\_\_

4. Fill-in-the blank definition as used in VA from one of the following words:

Value, Value Analysis, Life Cycle Costing, Function, Cost, Worth.

\_\_\_\_\_ is an economic assessment of competing design alternates using the principle of equivalent costs.

\_\_\_\_\_

5. Fill-in-the blank definition as used in VA from one of the following words:

Value-Cost, Value Analysis, Life Cycle Costing, Function, Cost, Worth.

\_\_\_\_\_ is the specific work a design/item must accomplish.

\_\_\_\_\_

6. Fill-in-the blank definition as used in VA from one of the following words: Value, Value Analysis, Life Cycle Costing, Function, Cost, Worth.

\_\_\_\_\_ is the lowest cost to perform the required functions

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### 7. Relationship of Value to Function, Cost, Quality is?

Value = Function x Quality / Costs

Value = Function + Quality / Costs

Value = Function + Costs / Quality

### 8. The Reasons for Unnecessary Costs Are?

Lack of information

Lack of ideas

Temporary circumstances

Honest wrong beliefs

Habits and attitudes

Changes by the owner

### 9. As early as possible is the Ideal Time to Apply VA?

True

False

### 10. Where has the greatest impetus for VA originated?

Private industry

The process area

U.S. Government

**END OF COURSE**

