

CHAPTER 19 – VALUE ANALYSIS

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CHAPTER 19 – VALUE ANALYSIS

ARTICLE 1 – Introduction and Definitions

Introduction

Value Analysis (VA) or Value Engineering (VE) is a function-oriented, structured, multi-disciplinary team approach to solving problems or identifying improvements. The goal of any VA Study is to:

Improve value by sustaining or improving performance attributes

(of the project, product, and/or service being studied)

while at the same time reducing overall cost

(including lifecycle operations and maintenance expenses).

The purpose of this chapter is to define the policies and procedures of the VA process within Caltrans (the Department).

Background

In 1947, engineer Lawrence Miles originated the Value Analysis System while working for General Electric. The original five-step process included:

1. Information
2. Analysis
3. Creativity
4. Judgment
5. Development

The VA methodology was adopted and renamed by the United States Navy, popularizing the term Value Engineering. The use of value engineering continued to expand throughout the federal government over the next two decades. Today nearly every federal agency with construction or purchasing responsibility is using this methodology. VA is an improvement tool that is applicable to any customer-based endeavor.

Caltrans' VA program has evolved over the years since the first study was conducted in 1969. The majority of VA studies are employed to improve projects, but a growing number of studies are sponsored to improve work processes in order to respond to changing customer needs, new regulatory or policy challenges and technology advances.

Definitions

Bridge: According to FHWA, a bridge is a structure including supports erected over a depression or an obstruction, such as water, a highway, or a railway, and having a passageway for carrying traffic or other moving loads, and with an opening measured along the center of the roadway of more than 20 feet between under copings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes. It may also include multiple pipes, where the distance between openings is less than half of the smaller contiguous opening.

Cost: The sum of all costs involved in delivering a project, product or process. This includes capital cost to construct, support cost to develop the project, ownership cost to operate and maintain, user-benefit cost (e.g., motorist savings resulting from increased level of service) and the time value of money (Net Present Value – NPV).

Function Analysis: The process of discerning the elemental functions comprising a project, product, or service.

Function Analysis System Technique (FAST) diagram: A method of mapping the relationships between functions within a project. Functions are analyzed by aligning them in a “how” and “why” logic diagram.

Job Plan: Defines the VA study procedure. FHWA has approved Caltrans’ eight-step VA study procedure. See Procedures for details.

Performance Attributes: Specific characteristics which are essential to achieve a project’s objective. These variable characteristics can possess a range of values and can be measured either qualitatively or quantitatively.

Performance Criteria: Performance is the capacity of a project, product or process to fulfill its intended function. Consensus on the primary performance expectations is critical.

Performance Criteria Matrix: A technique using the paired comparison method of evaluating the importance of performance attributes in meeting the project’s purpose and need.

Performance Requirements: Characteristics of the project, product, or process necessary to comply with regulations and policies. Requirements are absolute and must be explicitly met.

Projects: Transportation projects, as defined by FHWA, are defined in the Environmental Document (ED) and may include multiple construction contracts over many years.

Return on Investment (ROI): The cost savings or performance benefit realized from the implementation of a VA study alternative. Calculated by dividing the savings/benefit of the alternative by the cost of the study. Also can be described as a ratio (i.e., 10:1).

VA/VE: Systematic application of techniques by a multi-disciplinary team to improve the value of a project, product, or process by identifying and evaluating functions. The study objective is to provide the basic functions of the project, product or process at the lowest overall cost. The primary goal of a VA/VE study is to improve value.

VA and VE are used interchangeably throughout the manufacturing and transportation industry. Many Federal agencies, including the FHWA, use the term VE while the Department uses VA. In this manual, VA will be used.

Value: The relationship between performance of a project, product, or process and the cost of obtaining it. Optimum value is reached by maximizing performance while minimizing cost. Value can be expressed as:

$$V_{\text{value}} = \frac{P_{\text{performance}}}{C_{\text{cost}}}$$

Value Matrix: A technique for organizing cost and performance data in order to compare value alternatives to the project baseline.

Value Metrics: A technique to define, evaluate and measure performance of a project, product or process.

ARTICLE 2 – Legislative Statutes

National Highway System Act

Passage of the National Highway Systems (NHS) Act of 1995 included a mandate directing the U.S. Secretary of Transportation to develop a program requiring State Departments of Transportation (DOT) to carry out a VA study for all Federal-aid projects on the NHS costing \$25 million or more. The Federal Highway Administration (FHWA) published its VA Regulation implementing this mandate on February 14, 1997.

Title 23 United States Code (USC), Section 106 requires State DOTs to establish a program to improve project quality, reduce project costs, foster innovation, eliminate unnecessary and costly design elements, and ensure efficient investments by requiring a VA study. A VA study means the systematic process of review and analysis of a project, during the concept and design phase, by a multidiscipline team of persons not involved in the project. The study is conducted to provide recommendations for providing the needed functions safely, reliably, and at the lowest overall cost, improving the value and quality of the project, and reducing the time to complete the project. The State DOTs must ensure that a VA study has been performed on all applicable projects and that all resulting, approved recommendations are incorporated into the plans, specifications and estimate. The legislation requires the State DOT's VA program to administer procedures that at minimum, include the following activities:

- Identification of candidate projects for VA study.
- VA study process following FHWA's approved VA "job plan"
- Clearly defined roles and responsibilities of VA study participants and study coordinators
- Guidance on VA Study timing requirements and scheduling to ensure optimum results
- VA Study decision-making, implementation, reporting and monitoring requirements

The procedures outlined in this chapter and Caltrans' VA guidance ensure that VA studies comply with the Federal mandate for project studies.

There is no "Exception Process" to the federally mandated VA requirement. Failure to comply could jeopardize the project's funding, future funding, and/or loss of the Caltrans' delegation authority.

Often a corridor's "parent" project is segmented into sub-projects to better facilitate project funding. If a VA study was conducted on the parent project analyzing the entire project corridor, as defined by the Environmental Document (ED), then any subsequent contracts (or sub-projects) will be in compliance with the federal VA requirement. However, if a VA study was not conducted on the entire project corridor, as defined by the ED, then all the sub-projects would need a VA study for compliance.

SAFETEA-LU

In 2005, the federal government enacted the "Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users" (SAFETEA-LU) with new provisions and regulations. The previous legislation limited the VA study requirement to Federal aid projects on the NHS. SAFETEA-LU expanded the scope of the 1995 Value Engineering legislation to include all projects on the Federal-aid system with an estimated project cost (capital and support costs) greater than or equal to \$25 million. Title 23 USC Section 103 describes the "Federal-aid system" as the NHS and the Interstate System. Specific requirements that SAFETEA-LU enacted are:

- All projects on the Federal-aid system, regardless of funding, with an estimated total project cost greater than or equal to \$25 million.
- All bridge projects with an estimated total cost of \$20 million or more.
- Any other project designated by the U.S. Secretary of Transportation.
- The Secretary may require more than one VA Study for major projects over \$500 million.
- VA studies can be performed during the planning or design phase of the project.

For more information on the *Federal Highway Administration (FHWA)* VA Program and the VA legislation, refer to their web site: <http://www.fhwa.dot.gov/ve/index.htm>.

ARTICLE 3 – Policies

Overseen by the FHWA, Caltrans will maintain a value analysis program to insure the effective use of the VA applications throughout the project development process. Caltrans is mandated by Title 23 United States Code (USC), Section 106 as amended by SAFETEA-LU to perform a VA study on all projects on the Federal-aid system with a total project cost (right of way, construction, and support) of \$25 million or more regardless of whether Caltrans employees, local agencies, consultants, or others are accomplishing and/or funding the work. In addition, a VA study will be performed on all bridge projects with a total project cost of \$20 million or more.

VA studies should be performed on all projects totaling \$15 million or more to take advantage of the VA tools to enhance the project's value and to avoid having to perform the study late in the project development process if project costs should escalate above the mandated thresholds. The VA study is most effective in the beginning stages of project development, but it may be performed at any stage of project development. The project is defined by the environmental document and may consist of several construction contracts or phases.

The VA study must follow the VA Procedures (Job Plan) as described in this chapter. Deviation from the Job Plan could jeopardize Caltrans' compliance with the law. Caltrans' VA Program Manager can approve deviations from the Job Plan. Job Plan modifications are described later in this chapter.

Also, there is no "Exception Process" to the federally mandated VA study. Failure to comply could jeopardize the project's funding ability, future funding, and/or loss of Caltrans' delegation authority.

ARTICLE 4 – Benefits of VA

VA is an effective problem solving and quality assurance tool that can facilitate Caltrans goals, to maximize Safety, Mobility, Delivery, Stewardship, and Service. VA studies should be considered to:

- Meet or exceed standards and safety objectives
- Foster a team approach to problem solving and project development
- Improving a project's performance while maximizing quality
- Identify and develop strategies to mitigate or avoid risks and the associated costs
- Identify opportunities which promote Context Sensitive Solutions
- Validate project's scope, need and purpose, and baseline design

VA studies provide an opportunity for a structured and thorough review by functional experts. VA studies often reveal new information that fosters a project's advancement in a timely manner.

VA is an effective tool to ensure that Caltrans' responsibilities and liabilities as owner of the facility are adequately addressed in the project design. Caltrans has unique concerns, not to mention liability, for highway users' safety, environmental impacts and regional travel that may need to be balanced, but not compromised, with competing project objectives of partner agencies and project stakeholders.

With careful preparation and coordination, VA can aid in obtaining project stakeholder consensus on key project decisions, leading to the best possible design that is sensitive to the context of the impacted communities and environment.

Often, the earlier a VA study is undertaken, the more beneficial it will be. Conducting studies in the later phases of a project, after a significant amount of time and money has been committed to a chosen design, diminishes the opportunity for identifying viable improvements without compromising the delivery schedule.

The "Benefit Matrix", [Table A](#), depicts the benefits that can be derived during the following four primary phases of Project Development:

1. Concept – Development of the Project Initiation Document (PID) or Project Study Report (PSR)
2. Approval – Activities to gain "Project Approval" and regulatory acceptance through the Environmental Document (PAED)
3. Final Design – Development of Plans, Specifications and Estimates (PS&E)
4. Construction – Analyzing constructability, identifying and assessing Cost Reduction Incentive Proposals (CRIP) and/or evaluating the merit of proposed Construction Change Orders (CCO). A Study during the construction phase does not meet the 23 USC 106 requirements.

TABLE A
Potential VA Benefits vs. Project Timing

Potential VA Benefits Scale ● = High ◎ = Medium ○ = Low	Concept	Approval	Final Design	Const.
	PID/PSR	PAED	PS&E	CCO
Supports sound decision-making	●	●	●	●
Develop solutions to difficult engineering challenges	●	●	●	●
Identify/assess risk and associated cost	●	●	●	●
Reduce Project Development Support Cost – Expedite Delivery	●	●	●	●
Extend expected (LOS) service life	●	●	●	◎
Reduce Capital Cost to Construct	◎	●	●	◎
Reduce Cost to Operate/Maintain	◎	●	●	○
Clarify Need and Purpose	●	◎	○	○
Ensure Land Use compatibility	●	◎	○	○
Identify best alternatives to meet Caltrans’ safety and performance standards	◎	●	◎	○
Early discovery of opportunities and constraints	●	●	◎	○
Build stakeholder consensus	●	●	◎	○
Obtain input from community representation	●	●	◎	○
Avoid/Minimize Environmental Impacts	●	●	◎	○
Avoid/Minimize R/W Impacts	●	●	●	○
Improve modal choices and connectivity	●	●	◎	○
Identify optimum phasing/staging opportunities	◎	●	●	○
Validate project scope	◎	●	●	○
Validate/Refine current project design	○	◎	●	○
Reduce the need for Construction Change Orders	○	◎	●	○

ARTICLE 5 – VA Application

In addition to transportation projects, the VA process can be effectively applied to other Caltrans products and processes. To propose a study, contact the HQ VA Program Manager or your District VA Coordinator (DVAC) for more information. VA is typically applied to the following:

I. Transportation Project Studies

VA's positive impact on projects has been demonstrated during the key project development phases.

- Project Initiation (K-phase)
- Project Approval – Environmental Document (PAED/0-phase)
- Plans, Specifications & Estimates (PS&E/1-phase)
- Construction (4-phase) Projects already in construction may be value analyzed at the discretion of the contractor and as specified in the construction contract's special provisions, leading to cost-reduction incentive proposals. The Construction Division administers these studies. Construction Studies do not meet the FHWA requirement of performing VA.

Consult [Table A](#), “Potential VA Benefits vs. Project Timing”, for guidance on when to schedule a study in order to achieve one or more specific objectives.

II. Product Studies

The VA methodology can also improve the quality of highway products. Products are items and systems described in Caltrans' Standard Plans and Specifications, including reports and other documents Caltrans develops for various customers. Value Analysis can help identify products that need to be updated due to changing technology, outdated applications or other changes that affect standards. For instance, VA studies of headlight glare screens, concrete barriers, and overhead signs have led to statewide modifications.

III. Process Studies

VA can improve the effectiveness of Caltrans processes, such as policies, procedures, and business practices. Process study topics that have benefited from VA studies include workload balancing, project development procedures, intergovernmental reviews, district business plans, information access and distribution, regional strategic traffic operations plans, tort liability claims, maintenance operations, and support services.

IV. Hybrid Project/Process Studies

The VA methodology can be used to develop or improve a process impacting a specific project. Examples include VA studies that developed approaches for managing a design-build project or developed project specific strategies for meeting National Pollutant Discharge Elimination System (NPDES) objectives.

ARTICLE 6 – VA Roles & Responsibilities

This article defines the Roles and Responsibilities for those involved in the VA process. There are many people involved in the VA process. Each plays a vital role in the success of the VA program. The people involved with VA include:

The VA Administrators:

Federal Highway Administration (FHWA)
Headquarters VA Program
District/Region VA Coordinators (DVAC)

Study Sponsors and Key Decision-makers

Program/Project Managers
Executive Management/Decision Makers
Study Stakeholders/Community Representatives
Local Agencies

The VA Study Team

VA Team Leaders/Facilitators
Full-time VA Team Members
Part-time VA Team Members Participants
Technical Reviewers

I. The VA Administrators

A. Federal Highway Administration (FHWA)

The FHWA Value Engineering Coordinator of the California Division, in cooperation with the Value Engineering Office in Washington D.C., supports Caltrans' Value Analysis program by:

1. Providing guidance and direction on all Value Analysis/Value Engineering federal legislation related to transportation.

2. Ensuring compliance with the federal legislation and subsequent rulings relevant to VE/VA.
3. Reporting Caltrans' VA study results to the FHWA Value Engineering Office in Washington D.C.
4. Participating in the selection and acceptance of VA study recommendations.
5. Participating in the nomination, selection and presentation of annual VA awards.
6. Recruiting local FHWA employees to serve as VA team members.
7. Participating with the VA program on important activities such as annual District Value Analysis Coordinator's meeting, Value Analysis conferences, and meetings with Caltrans management to discuss the role and future of the Value Analysis Program.

B. Headquarters VA Program

The Value Analysis program is located within the Division of Design in Headquarters. The FHWA has delegated the authority to maintain the VA Program within Caltrans. Following are responsibilities of Caltrans' VA Program:

1. Assuring compliance with the federal VE/VA requirements.
2. Preparing and submitting annual reports to FHWA and Caltrans management.
3. Reporting statewide results of CRIPs to the FHWA in cooperation with the Division of Construction.
4. Setting policy and procedures for the VA program.
5. Updating VA guidance materials and reference manuals (including this Chapter).
6. Forecasting VA demand to ensure adequate resources.
7. Developing, coordinating and monitoring the statewide annual VA program including fiscal management of the VA program allocation for consultant services.
8. Maintaining VA consultant service contracts.
9. Provide VA training opportunities to Caltrans.
10. Coordinating Headquarters sponsored VA studies.
11. Supporting and encouraging the development of expertise to ensure successful VA studies.
12. Assessing and sharing VA best practices and "lessons learned".
13. Monitoring VA studies to assure adherence to the VA methodology.
14. Marketing VA results and recognizing accomplishments with VA awards.
15. Participating on the AASHTO Value Engineering Sub-committee (optional).

C. District/Region VA Coordinators

Each district (or region) must have a VA Coordinator (DVAC). The coordinator's function is to assure the proper application of VA policies and procedures. The DVAC consults with VA Study sponsors and key decision-makers to identify improvement opportunities, scope, schedule, ideal team member candidates and study logistics, including meeting locations, study field trips and data collection. The coordinator also monitors and reports district VA studies to district management and to the Headquarters (HQ) VA program. The following lists the duties of the DVAC:

1. Coordinate with HQ VA program on all VA activities
2. Coordinate the development of the District's Annual VA program. This includes:
 - Working with District project and functional managers to identify Project (voluntary and federally mandated), Product and Process Studies
 - Obtaining the District Director's approval for the annual VA program
 - Updating the program over the duration of the year as needed
3. Manage the District/Region VA program to identify and check the availability of qualified team leaders and experienced team members to participate on the studies.
4. Ensure VA studies are conducted in accordance with Caltrans VA policies and approved procedures by performing the following duties:
 - For consultant-led studies, the DVAC will write and submit task orders to request consultant services under executed VA service contracts. Task orders must be written after being in consultation with the project manager, key functional units and key stakeholders.
 - Assist HQ VA Program to manage the yearly allocation of VA funds and types of funds provided to that District.
 - Schedule study dates including due dates for key deliverables and secure meeting room location(s) for the study meeting dates.
 - Notify study participants of the study dates, agenda and location
 - Ensure that the VA team leader and team have adequate background data to generate sound assumptions and analysis
 - Monitor study activities to assure adherence to the standards as defined in the VA manuals (auditing of study workshops).
 - Ensure VA study preparation activities are completed, including follow-up on implementation results.
5. Maintain hard copies and electronic files of all completed VA study reports.
6. Advocate the merits of VA by reporting/marketing study results and participant contributions (assist FHWA, AASHTO and Caltrans VE/VA awards programs and other recognition efforts)

7. Support HQ in monitoring legislative compliance, including audits and special report requests.
8. Assist HQ VA Program on assessing the cost and return on investment (ROI) of the Districts/Regions' VA Studies.

II. Sponsors & Key Decision-makers

A. Project Sponsors

Project Sponsors serve as project advocates. They secure funding for the preparation and completion of activities at the project team and functional level to ensure compliance with Department policies, standards and practices including VA.

B. Program/Project Managers

Generally District Program, Corridor and/or Project Managers are the primary sponsor for VA studies and help to ensure a successful study they are responsible for by:

1. Identifying highway projects to be value analyzed.
2. Ensuring VA studies are conducted on projects needing to comply with the federal VA law.
3. Providing adequate resources for the required and/or desired VA study into the project work plan budget and schedule.
4. Ensuring legislative compliance when the Department provides design oversight services for all projects on the Federal aid system.
5. Identify the need for a VA study on locally funded projects (All projects on the Federal aid system totaling \$25 million or more and any bridge project \$20 million or more).
6. Initiate a formal cooperative agreement as early as possible in the project development stage prior to incurring any costs and/or commitment of personnel resources.
7. Working with the DVAC to develop the VA study charter to outline the study's scope, objectives, participants and schedule.
8. Helping the DVAC recruit the most qualified VA team members, this may include sub-consultant experts, who can work directly with other multi-disciplined team members on various project issues.
9. Resolving the implementation dispositions of VA alternatives (accept, accept with modification(s), conditionally accept, or reject).
10. Ensuring legislative compliance by implementing all accepted alternatives into the project.

C. Executive Management/Decision Makers

Throughout the study duration, all relevant decision-makers should be involved, particularly for study preparation, the initial study kick-off meeting, team VA presentation and post study review activities. Having key decision-makers actively engaged and providing input to the VA team provides the necessary interaction to ensure that the VA study results in viable and beneficial VA recommendations. Their responsibilities include:

1. Support the Study coordinators (Project Managers and DVACs) to recruit the best team members and study participants.
2. Review the study charter and attend the study kick-off meeting to make sure all-important issues and study objectives are adequately addressed.
3. Provide the “Implementation Disposition” and decision rationale for each VA team recommendation.
4. Attend Implementation meeting and approve each recommendation with an Accept, Conditionally Accept or Reject decision.
5. Provide input on “Conditionally Accepted” alternatives to the Team Leader. Identify responsibilities and time schedules needed to resolve “Conditions”.
6. Recognition of VA contributions and team member acknowledgements.

D. Study Stakeholders/Community Representatives

Throughout the study activities, Stakeholders and Community Representatives are encouraged to participate. The Kick-off and implementation meetings are specifically designed to include these part time study members so their thoughts and concerns can be met in the Study objectives and outcomes.

E. Local Agencies

Caltrans Division of Local Programs is responsible for assuring that a VA study has been performed on a local agency project. The Local Agency, in compliance with Caltrans’ Policy and Procedures, must follow the VA requirement defined in this chapter. These responsibilities include:

1. Compliance with Caltrans’ VA job plan on all projects as defined by the VA policy.
2. Provide written documentation of the VA study as defined by the Caltrans Report guidance.
3. Provide the Project Manager and/or DVAC with hard copy and electronic copy of the VA Report.
4. Enter into a Cooperative Agreement defining detailed information about the Study costs, schedule, team leader, and requirements of the proposed VA study.
5. Provide qualified Team members to participate in VA study when applicable.
6. Attend kick-off and implementation meeting on Local projects.

III. The VA Study Team

There are many activities involved in a VA study. These activities are outlined in the following Article ([Article 7](#) – VA Study Job Plan) of this manual. There are several categories of participants involved in a VA Study. Each plays an important role in the success of the VA Study. The participants include a Team Leader, Team Members (full and part time), Stakeholders, and Decision Makers.

A. VA Team Leaders/Facilitators

The Team Leader generally is responsible for:

1. Meeting with Project Stakeholders, decision makers and team members in preparation of a VA study.
2. Leading the VA team through the VA methodology.
3. Documenting the VA alternatives to ensure clear, thorough communication of the VA team's concepts.
4. Preparing the VA report, following the requirements outlined in the VA Report Guide, in a timely fashion to the districts and HQ VA program manager.
5. Providing electronic and/or hard copies to all interested parties.
6. Ensuring the VA Study is in compliance with Departmental policy.
7. Performing a follow-up on the implementation plan.

B. Full-time VA Team Members

VA team members are recruited from Caltrans staff, government agencies and occasionally supplemented by consultants with desired technical expertise not readily available within Caltrans. External project stakeholders are encouraged to participate as team members. Studies must be performed using multi-disciplined teams of individuals open to changes to the current design of the project. To establish the team's authority, it is recommended that the DVAC obtain a memorandum signed by an appropriate high-ranking District manager, appointing team members to the study.

The experience and knowledge of the team members must match the complexity of the project being studied. Team members must be capable of working within a team environment, be willing to express themselves and be willing to listen to the ideas of others. Specifically, the VA team includes specialists who can develop and determine the technical, economic, political, and environmental feasibility of alternatives included in the project scope. Headquarters' staff such as Project Development Coordinators, Traffic Safety Coordinators, Design Reviewers, Environmental Coordinators, Environmental Planners, Transportation Planners,

Maintenance and specialists from New Technology, Materials & Research should be recruited as needed.

VA teams typically consist of five to ten members, including the team leader. Teams within this range are effective, as they are large enough to represent the project's key technical areas of expertise, while small enough to achieve the desired cohesiveness and synergy. Teams of this size also demonstrate efficient use of resources for project studies.

Full-time VA Team members are expected to have:

1. Competency in their field of expertise.
2. Time to devote to the entire duration of the VA study. Team members (or their supervisors) are not allowed to send a delegate to participate in their absence (unless illness or an emergency prevents the team member's continued participation).
3. Preparation time to review the project prior to the study.
4. Skills and the mindset to complete all necessary VA study tasks, including writing VA proposals and estimating costs.
5. An open mind, a belief that there is always room for improvement and willingness to share and debate the pros and cons of VA alternatives.
6. Post study workshop time to review and comment on the Preliminary VA study report and participate on the VA Study implementation meeting.

C. Part-time VA Team Members (Caltrans/ Consultants)

Part-time VA team members are an essential part of the VA Study. These part time members include Technical Reviewers, Caltrans or Consultant Technical Experts, Project Managers, Project Development Team (PDT) members, Community Representatives, Project Stakeholders, and Project Decision Makers.

Part-time team members are:

1. Not required to attend all of the VA study activities.
2. May include local agencies or community representatives (or any interested party).
3. Should be invited to the stakeholder issues discussion on the first day of the study (Kick-off meeting).
4. Should serve as technical advisors and/or reviewers.
5. Should provide comments and/or feedback during the study. Especially when reviewing Preliminary or Draft documents.
6. May participate during the brainstorming phase of the study.

D. Technical Reviewers

The Project Manager identifies technical reviewers, responsible to review and comment on the technical viability of the VA alternatives and to identify any issues that need to be addressed. Comments should be well documented and clearly cited with advantages and disadvantages. Technical reviewers do not make decisions regarding the VA alternative. Technical reviewers should include individuals from functional units reflected in the Project Development Team and relevant Headquarters advisors.

[Table B](#) below summarizes the roles and responsibilities for the individual activities involved in a study/workshop.

TABLE B
Workshop Responsibilities

Workshop Responsibilities	Study Sponsor (s) or Project Manager	DVAC	HQ VA	Team Leader	Team Member	Stakeholders / Technical Advisors	Executive Mgmt. Decision-makers
Pre-VA Study							
Ensure legislative compliance (including local projects)	X	X	X				
Address VA in Project Study Reports and Project Reports (per CTC requirement)	X						
Identify projects to be value analyzed	X	X	X				X
Ensure adequate resources are available for study	X	X	X	X			
Determine study scope, objectives and participants	X	X	X				X
Determine study schedule	X	X		X			
Recruit ideal full-time team members and part-time participants as well as sub-consultant experts if needed	X	X					X
Develop and approve Study Charter	X	X					
Participate in Pre-study planning meeting	X	X		X			
Gather and disseminate adequate data to generate sound assumptions and analysis	X	X		X			
VA Study							
Attend and participate in Study Kick-off meeting discussion	X	X		X	X	X	X
Provide phone/email data and be available to support the team to answer questions	X	X		X	X	X	X
Participate in field review	X	X		X	X		
Attend mid-point review (if scheduled)	X	X		X	X	X	X
Develop formal VA Team Alternatives with cost estimates, and sketches (if applicable)				X	X		

Workshop Responsibilities	Study Sponsor (s) or Project Manager	DVAC	HQ VA	Team Leader	Team Member	Stakeholders / Technical Advisors	Executive Mgmt. Decision-makers
Rate and compare performance between VA alternatives and to baseline/existing option				X	X		
Review and validate team assumptions, findings, calculations	X					X	X
Determine/invite participants to the VA team's presentation and preliminary report reviewers	X	X					
Attend VA team presentation meeting	X	X		X	X	X	X
If needed, identify action items for additional analysis	X	X		X		X	X
Set post workshop schedule for preliminary report review and the implementation meeting	X	X					
Post VA Study							
Review report and provide specifics comments or requests for clarification	X	X			X	X	X
Participate in the implementation meeting	X	X		X	X	X	X
Provide rationale for acceptance, conditional acceptance or rejection of VA Alternatives	X						X
Distribute Final Study Reports		X		X			
Acknowledge VA Participants' effort and contributions	X	X		X			X
Follow-up on conditionally accepted alternatives	X	X		X			
Maintain hard copies and electronic files of all completed VA study reports	X	X	X	X			

ARTICLE 7 – VA Process and Procedures

Currently, Caltrans employs the following eight-step VA procedure (Job Plan) to meet the FHWA requirements:

1. Preparation
2. Information
3. Function Analysis
4. Speculation
5. Evaluation
6. Development
7. Presentation
8. Implementation

Many activities are involved in each step of the process. Basically, the Job Plan can be separated into three major categories: Preparation, VA Study/Workshop, and Reporting.

The VA study or workshop is separated into three segments. Segment 1 is for the Information, Function Analysis, Speculation and Evaluation phase of the study. Segment 2 includes developing the alternatives and presenting them to the stakeholders of the project. Once the alternatives have been presented, the preliminary report is written and distributed for comments. Segment 3 of the study begins by gathering the comments, and scheduling an Implementation meeting with the stakeholders and decision makers to discuss the implementation of the approved alternatives into the project. Upon completion, a Final report will be prepared discussing the results of the study.

[Tables C](#) and [D](#) outline all the VA study activities and the people involved in the VA study, respectively. Also, refer to Article 6 (roles and responsibilities) [Table B](#) for clarification. For more details, please refer to the VA Team Guide found on the Caltrans VA website.

<http://www.dot.ca.gov/hq/oppd/value/guides.htm>

Study Schedule

Typically, five to seven days (40 to 70 hours) of meeting time are required to conduct a VA study for a project. The study results should be finalized within 8-10 weeks of the start of the study.

During study preparation, the Project Manager (PM), the DVAC and Team Leader customize the typical VA Study work plan for the project and determine the approximate number of hours to be spent. It becomes the responsibility of the Team Leader to meet this schedule.

A typical model for the Caltrans VA highway study is to conduct Segments 1 and 2, see [Table C](#), of the VA Study in two three-day sessions of eight hours each day, separated by no more than one week. Segment 3, see [Table C](#), is conducted 3-5 weeks after the conclusion of Segment 2 to finalize the implementation disposition of the VA alternatives. This time is necessary to permit completion and distribution of the preliminary report by the team leader, and to review and comment on the VA alternatives by the PDT, technical reviewers and stakeholders. The VA report is due within two weeks of the completion of Segment 3.

Alternative Study Schedule

In some cases, it is desired to perform a shortened study (3-5 days for Segment 1 and 2, see [Table C](#)). There is an exception process to receive approval for a shortened study. The DVAC, in conjunction with the PM and Team Leader, may submit a “Modified Job Plan Proposal” to the Headquarters’ VA Program Manager. The form is found on the VA intranet website:

<http://pd.dot.ca.gov/design/specproj/value-analysis.asp>

A description of the project along with a proposed schedule (job plan) must be submitted to Headquarters prior to approval. Acceptance of the modified Job Plan will be based on Study Scope, Complexity of the Project, Project Schedule, and duration of the study. Decisions will be made on a project-by-project basis and may require FHWA approval. One-day studies are not acceptable as valid VA studies. An acceptable job plan cannot be accomplished in one day.

TABLE C
Value Analysis Study Activity Chart

PREPARATION		INITIATE STUDY > Identify study project > Identify study roles and responsibilities > Define study goals > Select team leader > Prepare draft Study Charter 1	ORGANIZE STUDY > Conduct Pre-Study Meeting > Select team members > Identify stakeholders, decision-makers, and technical reviewers > Identify data collection > Select study dates > Determine study logistics > Update VA Study Charter 2	PREPARE DATA > Collect and distribute data > Develop construction cost models > Develop highway user benefit / life cycle cost (LCC) model 3	
	VA STUDY	Segment 1	INFORM TEAM > Review study activities and confirm reviewers > Present design concept > Present stakeholders' interests > Review project issues and objectives > Identify key functions and performance criteria > Visit project site 4	ANALYZE FUNCTIONS > Analyze project data > Expand project functions > Prepare FAST diagram > Determine functional cost drivers 5	CREATE IDEAS > Focus on functions > List all ideas > Apply creativity and innovation techniques (group and individual) 6
Segment 2		DEVELOP ALTERNATIVES > Develop alternative concepts > Prepare sketches and calculations > Measure performance > Estimate costs, LCC benefits/costs 8	CRITIQUE ALTERNATIVES > VA Alternatives Technical Review > VA Alternatives Team Consensus Review > Identify mutually exclusive groups of alternatives > Identify VA sets Validate performance 9	PRESENT ALTERNATIVES* > Present findings > Document feedback > Confirm pending reviews > Prepare preliminary report *Interim presentation of study findings 10	
Segment 3		ASSESS ALTERNATIVES** > Review Preliminary Report > Assess alternatives for project acceptance > Prepare draft implementation dispositions **Activities performed by PDT, Technical Reviewers, and Stakeholders 11	RESOLVE ALTERNATIVES- > Review implementation dispositions > Resolve implementation actions with decision-makers and stakeholders > Edit alternatives > Revisit rejected alternatives, if needed 12	PRESENT RESULTS* > Present results > Obtain management approval on implemented alternatives > Summarize performance, cost, and value improvements *Final presentation of study results 13	

REPORT	PUBLISH RESULTS	- CLOSE OUT VA STUDY
	➤ Document process and study results	(if Conditionally Accepted Alternatives exist)
	➤ Incorporate all comments and implementation actions	➤ Resolve Conditionally Accepted Alternatives
	➤ Distribute Final VA Report	➤ Finalize VA Study Summary Report (VASSR)
	➤ Distribute electronic report to HQ VA Branch	➤ Finalize Performance Measures
	➤ Update VA Study Summary Report (VASSR)	➤ Finalize VA Report Executive Summary and provide electronically to HQ
	➤ Provide HQ the Final VA Report in pdf format	
	14	15

Note: The dashed boxes indicate steps that *may* not be required in some VA Studies.

TABLE D
Value Analysis Job Plan Participation Chart

VA Activity Preparation	DVAC	PM	PDT	Technical Reviewers	HQ VA Program	External Stakeholders	Executive Mgmt.	Team Leader	VA Team
INITIATE STUDY									
➤ Identify study project	X	X							
➤ Identify study roles and responsibilities	X	X			X				
➤ Define study goals	X	X							
➤ Select team leader	X	X			X				
ORGANIZE STUDY									
➤ Conduct preparation meeting	X	X	X					X	
➤ Select team members and advisors	X	X	X					X	
➤ Identify stakeholders, decision-makers and technical reviewers		X							
➤ Identify data collection	X	X	X					X	X
➤ Select study dates	X	X	X					X	X
➤ Determine study logistics	X							X	
PREPARE DATA									
➤ Collect and distribute data	X	X	X					X	
➤ Develop construction cost models								X	X
➤ Develop highway user benefit LCC model								X	X

VA Activity Segment 1	DVAC	PM	PDT	Technical Reviewers	HQ VA Program	External Stakeholders	Executive Mgmt.	Team Leader	VA Team
INFORM TEAM									
➤ Review study activities/ confirm reviewers	X	X							
➤ Present design concept		X	X						
➤ Present stakeholders' interests		X				X			
➤ Review Project Documents	X	X	X	X		X		X	X
➤ Review project issues and objectives		X	X					X	X
➤ Develop performance criteria		X	X	X		X		X	X
➤ Visit project site	X	X	X			X		X	X
ANALYZE FUNCTIONS									
➤ Analyze project data								X	X
➤ Identify project functions								X	X
➤ Prepare FAST diagram								X	X
➤ Determine functional/cost and functional /performance relationship								X	X
CREATE IDEAS									
➤ Focus on functions								X	X
➤ List all ideas								X	X
➤ Use group brainstorming								X	X
➤ Use individual brainstorming								X	X
EVALUATE IDEAS									
➤ Apply key evaluative criteria								X	X
➤ Rate each idea								X	X
➤ List advantages and disadvantages								X	X
➤ Rank all ideas								X	X
➤ Assign alternatives for development								X	X

VA Activity Segment 2	DVAC	PM	PDT	Technical Reviewers	HQ VA Program	External Stakeholders	Executive Mgmt.	Team Leader	VA Team
DEVELOP ALTERNATIVES									
➤ Develop alternative concepts								X	X
➤ Prepare sketches and calculations								X	X
➤ Estimate costs, LCC benefits/costs								X	X
➤ Measure performance								X	X
➤ Edit alternatives								X	X
CRITIQUE ALTERNATIVES									
➤ Review alternatives for team consensus								X	X
➤ Review alternatives for technical viability				X				X	X
➤ Validate performance								X	X
➤ Review pending study activities/ confirm reviewers	X	X		X				X	X
➤ Edit alternatives and incorporate comments								X	X
PRESENT ALTERNATIVES									
➤ Present findings								X	X
➤ Document feedback								X	X
➤ Confirm pending technical reviews		X	X	X		X	X		
➤ Prepare preliminary report								X	

VA Activity Segment 3	DVAC	PM	PDT	Technical Reviewers	HQ VA Program	External Stakeholders	Executive Mgmt.	Team Leader	VA Team
ASSESS ALTERNATIVES									
➤ Review preliminary VA report		X	X	X	X	X	X		
➤ Assess alternatives for project acceptance		X	X	X	X	X	X		
➤ Prepare draft implementation dispositions		X	X	X	X	X	X		
RESOLVE ALTERNATIVES									
➤ Review implementation dispositions	X							X	X
➤ Resolve implementation actions decision-makers and stakeholders	X	X	X	X		X	X	X	X
➤ Edit alternatives								X	X
➤ Revisit rejected alternatives, if needed								X	X
PRESENT RESULTS									
➤ Present results of study	X	X	X	X		X	X	X	X
➤ Reach final consensus and summarize study results on implemented alternatives.	X	X	X	X		X	X	X	X
PUBLISH RESULTS									
➤ Document process and results								X	
➤ Incorporate all comments and dispositions								X	
➤ Distribute VA report								X	
➤ Distribute electronic version to HQ VA Branch								X	
CLOSE-OUT STUDY <i>(if Conditionally Accepted Alternatives exist)</i>									
➤ Resolve Conditionally Accepted Alternatives								X	
➤ Finalize VA Study Summary Report (VASSR)								X	
➤ Finalize Performance Measures								X	
➤ Finalize VA Report Executive Summary and provide Electronically to HQ								X	

VA Study Report

The objective of a VA study is to develop a proposal to maximize performance while minimizing cost. The VA report contains all of the documentation needed to communicate the findings of the VA Study and facilitate implementation of the VA alternatives. The Team Leader is primarily responsible for gathering the documentation generated by the study team and compiling it systematically into a report.

Two reports, a preliminary and final, are generated for every study. The purpose of the preliminary report is to provide documentation of the VA alternatives to the reviewers and team members in order to get their response to the viability and acceptability of the alternatives. The preliminary report is typically prepared and distributed within two or three weeks after the VA Study. The final report is prepared after the implementation meeting to document the decision maker's comments, implementation plans, and decisions. The final report serves as the final documentation of the VA study.

Each VA study is summarized and documented using the VA Report guidelines which are found on the Caltrans VA website. <http://www.dot.ca.gov/hq/oppd/value/guides.htm>

The VA Study Report includes the following sections:

- Table of Content (P, F)
- Distribution List (P, F)
- Executive Summary (P, F)
- VA Study Summary Report (VASSR) (F)
- VA Alternatives (P, F)
- Project Analysis (F)
- Project Description (P, F)
- Idea Evaluations (P, F)
- VA Process (P, F)

P-Preliminary, F-Final

VA Alternative and Numbering Convention

Each alternative consists of a summary of the original concept, a description of the suggested change, a listing of its advantages and disadvantages, a cost comparison, change in performance, and a brief narrative comparing the original design with the alternative. Sketches, calculations, and performance measure ratings are also presented.

Many alternatives developed by the team have several variations. Alternatives are numbered sequentially (1.0, 2.0, 3.0). The .0 indicates this alternative does not have any competing ideas. When several competing ideas are developed and only one may be implemented, the same number is used with decimal designators (3.1, 3.2, 3.3) for the competing alternatives. The VA alternative number is independent of the original idea number.

VA Sets

The VA team establishes VA sets as their “best value” solutions, based on improved performance, likelihood of implementation, least community impact, cost savings, or any combination of criteria. A VA set may contain one or more alternatives, and each set is typically mutually exclusive of other sets (i.e., implementing VA Set 1 precludes implementation of VA Sets 2 and 3). VA sets are selected alternatives combined from mutually exclusive groups that can compete in whole, or in part, against the original design concept. This requires additional performance rating and totaling of costs for the sets.

An example of VA sets, see [Figure 1](#), is as follows: The VA team created two VA sets for the project. Both sets offer the potential to significantly reduce excavation work; simplify construction; reduce horizontal curve radii, thereby improving sight distance; and reduce the number of intersections and associated turning movements on the highway. Both sets suggest reduction in design speed in selected areas of the project, from 50 mph to 45 mph, or from 50 mph to 40 mph. Either of these two alternatives will give the designer greater flexibility to design around obstructions (including utilities) and existing topography. The reduction in design speed is consistent with the highway use and designation.

FIGURE 1
Summary of VA Alternatives

SUMMARY OF VA ALTERNATIVES <i>Example Project</i>		Caltrans	
No.	Description	Cost Savings Initial / Highway Use	Change in Value
1.1	Relocate / Consolidate / Improve At-Grade Intersections	\$885,000	+3%
1.2	Realign SR 64 Southbound and Reroute Solitude Road	\$16,183,000	+3%
1.3	Eliminate Wiley Drive Connection	\$1,700,000	+8%
2.1	Design Median Width for Projected Traffic Volumes	\$5,097,000	0%
2.2	Reduce Solitude Grade Median to 7 Meters, with Concrete Barrier for ~1,000 Meters	\$1,814,000	0%
3.0	Steepen Slopes to 1.5:1	\$6,420,000	+5%
4.1	Lower Design Speed to 45 mph in Selected Areas	\$6,409,000	+3%
4.2	Lower Design Speed to 40 mph in Specific Areas	\$9,853,000	+1%
5.0	Go Around the Oil Refinery; Realign Roadway to Intersect Utilities at 90°	\$1,011,000	+3%
6.1	Relocate 14/64 Interchange Beyond Wetlands	\$400,000	+2%
6.2	Design Simple Flyover at 14/64 Interchange	\$4,006,000	+4%
7.0	Eliminate asphalt treated permeable base (ATPB) and edge drains	\$3,170,000	0%
8.0	Undercrossing at Olive Hill Road with Interchange	(\$1,982,000) \$34,146,000	+15%

SUMMARY OF VA SETS

Set No.	Description	Cost Savings Initial / Highway User	Change in Performance	Change in Value
1	Use 40 mph design speed in selected areas (1.2, 2.1, 3.0, 4.1, 5.0, 6.2, 7.0, 8.0)	(\$1,982,000) \$42,296,000	26%	52%
2	Use 45 mph design speed in selected areas (1.2, 2.1, 3.0, 4.2, 5.0, 6.2, 7.0, 8.0)	(\$1,982,000) \$45,740,000	24%	52%

VA Performance Criteria

Performance criteria were established solely to better understand the advantages and disadvantages between competing alternatives. A consensus-driven approach is used to determine the relative magnitude of each performance objective by assigning a numeric weight. Interpreting the performance expectations into a numeric abstraction permits an unbiased assessment of value.

Caltrans has increased the significance of performance in determining the overall value score. By using the “Paired Comparison” method to obtain the team’s consensus on the relative importance of each performance attribute and to assign a numeric value for each attribute. Using the Performance Criteria Matrix, the VA team assigns numeric weights to the identified Performance Attributes by comparing the relative importance of each as it pertains to the project, product or process being studied. The example in [Figure 2](#) below assigns the weighted percentage score to each Performance Attribute in the project. The score is calculated by adding all the compared importance attributes and dividing by the total number of comparisons, i.e. five A’s divided by 21 equals 24%.

FIGURE 2
Performance Criteria Matrix

PERFORMANCE CRITERIA MATRIX <i>Example Project</i>							Caltrans	
							TOTAL	%
Mainline Traffic Operations	A	b	a	a	a	a	5.0	24%
Highway User Safety	B	b	b	b	b	b	6.0	29%
Access	C	c	c	c	c	c	4.0	19%
Local Traffic Operations	D	d	f	d			2.0	10%
Constructibility	E	f	e/g				0.5	2%
Environmental Impacts	F	f					3.0	14%
Right-of-Way Impacts	G						0.5	2%
							21.0	100%

a	More Important
a/b	Equal Importance

Once the weighted Performance Attributes are calculated, a comparison analysis of VA Alternatives is focused on the ability and extent of each alternative to satisfy a performance attribute. The VA team assesses each VA Alternative to determine the degree each causes beneficial or adverse impacts to the performance attributes. The team agrees on a qualitative value based on a scale of one to ten, ten being the highest potential benefit. When comparing against the baseline alternative, the value is set to five.

[Figure 3](#) below is used to calculate the Value Index of each alternative. If an attribute, such as Mainline Traffic Operations, is assigned a weighted value of 24 points (24%) and the alternative is evaluated to have a performance rating of eight points then the alternative's performance score for that attribute is 192 points (criteria weighted value multiplied by performance rating). Adding the points for all the performance attributes, creates a performance score for each VA Alternative (e.g., 677 in [Figure 3](#)). A Value Index score is calculated by dividing the performance score by cost (e.g., 677 divided by 235.6 (million) equals a 2.87 Value Index). This allows the team to present a value comparison between VA alternatives and the baseline design.

The difference between the score for the VA alternative, and the score for the project baseline concept, is expressed as a percentage of performance improvement or degradation. The optimum result is to develop VA alternatives with the potential to increase performance at a decreased cost. Often, the VA study will result in a set of alternatives that either decrease cost, but with a slight degradation in performance or the opposite, performance significantly increases with a slight cost increase.

FIGURE 3
Performance Rating Matrix

PERFORMANCE RATING MATRIX - Original Concept											Caltrans		
Example Project													
Criteria	Criteria Weight	Concept	Performance Rating										Total Performance
			1	2	3	4	5	6	7	8	9	10	
Mainline Traffic Operations	24	No Build	2										48
		Original Concept	8										192
Highway User Safety	29	No Build	4										116
		Original Concept	6										174
Access	19	No Build	3										57
		Original Concept	7										133
Local Traffic Operations	10	No Build	4										40
		Original Concept	7										70
Constructability	2	No Build											N/A
		Original Concept	7										14
Environmental Impacts	14	No Build											N/A
		Original Concept	6										84
Right-of-Way Impacts	2	No Build											N/A
		Original Concept	5										10
OVERALL PERFORMANCE			Total Performance	% Perf. Improve.	Total Cost	Value Index (Performance / Cost)		% Value Improvement					
Original Concept			677		235.6	2.87							

ARTICLE 8 – VA Study Charging Details

The VA study activities are resourced by two different funding sources. First, the HQ VA program maintains several A&E contracts with consultant Team Leaders on board to perform Caltrans VA studies. Team Leaders are Certified Value Specialists (CVS) with specific expertise not employed within Caltrans. Included in these contracts are provisions for Caltrans to hire consultants with specific expertise and/or experiences. The second source of funding is from the Expenditure Authorization (EA) of the project. Caltrans employee participation in the study will be charged to the EA of the project.

Typical Cost

Typical VA studies include a Pre-study meeting, six-day workshop, report writing, report review and comment period, and an implementation meeting. These activities generally take about 80 hours of work spread over a six-week period for each full-time team member. With typical studies having 6-8 team members, the Project Manager (PM) should include about 500-1000 hours for VA activities in the project work plan. The PM should also consider including 80 hours for the District VA Coordinator (DVAC).

Consultant Team Leader costs, including administrative fees, quality control, and traveling expenses, are allocated through A&E contracts and are administered by the HQ VA Program. Typical studies range from \$30,000 - \$40,000.

Although the cost of the study can be substantial, the results from each study are on average returning an 80:1 savings on investment. For each dollar spent on the study, Caltrans is realizing an eighty-dollar savings in initial cost and/or life-cycle cost on the project.

Typical Charging

Caltrans' Team Members should be charging their time directly to the project EA. VA activities are defined in the Work Breakdown Structure (WBS) for each phase of the project. An example of a typical project study in District 6 during the PID phase is as follows:

Source Dist.	Charge Dist.	EA	Subjob	Spec. Desig.	FAE	Activity Code	MSA
06	06	123456		6VA1234	1	150	P1010

Team members are encouraged to use a Special Designation to identify VA activities. The VA program uses the following Special Designation:

6VAxxxx - where **xxxx** is the Task Order number of the VA Study

Activity Code:	MSA
150 = Project Initiation Document (PID)	P10.10
160 = Perform Preliminary Engineering Studies and Prepare Draft Project Report	P10.20
185 = Prepare Base Maps and Plan Sheets	P15.20

Caltrans policy requires all on-call A&E contract expenditures to be charged against the specific project in which the work is being done. Team Leader expenses are encumbered directly to the project EA from the on-call contract holding EA administered by HQ VA Program. Task orders, expenses and billing for consultant services related to VA activities are the responsibility of the HQ VA Program.

ARTICLE 9 – VA Program Reporting

The HQ VA Program's results are reported to the FHWA and Caltrans management in an annual report prepared in October by the HQ VA Program Manager. These reports describe results of the VA studies performed over the Federal fiscal year (ending September 30). The report is used to calculate the return on investment (ROI) of the VA Program by comparing the Cost of the Study to the Amount of Savings.

The HQ VA Program also reports to FHWA on Caltrans “Cost Reduction Incentive Proposals” (CRIPs), the method to approve construction strategies developed by the construction contractor to reduce project cost. Please refer to the Caltrans’ Construction Manual for more details about CRIPs. Most other states use the name “Value Engineering Cost Proposals” (VECP) for similar programs.

The FHWA annual report includes:

- Number of VA Studies
- Cost of the VA Studies
- Number of Proposed Alternatives
- Number of Accepted Alternatives
- Value of Proposed Savings
- Value of Accepted Savings
- Total Cost of Projects being Studied
- Number of Construction VECPs
- Amount of VECP Savings
- Number of Employees Trained in VA

The FHWA annual report from previous years can be found on the web at:
<http://www.dot.ca.gov/hq/oppd/value/history.htm>