

## 220 Value Engineering

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### 220.1 General

Value engineering (VE) analysis is a systematic process of reviewing and assessing a project by a multidisciplinary team not directly involved in the planning and development phases of the project. The VE process incorporates the values of design; construction; maintenance; contractor; state, local, and federal approval agencies; other stakeholders; and the public.

The New Mexico Department of Transportation (NMDOT) conducts VE analyses early in project development either during project scoping or as part of Preliminary Design. The purpose of VE analysis is to identify ideas that might reduce cost, refine the definition of the project scope, improve design function, improve constructability, reduce the project schedule, and identify other value improvements, including reduced environmental impacts or congestion.

A VE analysis may be applied as a quick-response study to address a problem or as an integral part of an overall organizational effort to stimulate innovation and improve performance characteristics. Any project, regardless of its total cost, may be considered for a VE study. The objectives of VE are to:

- Maintain the project's function
- Minimize the life-cycle cost of a project
- Encourage innovation
- Highlight potential cost reductions on transportation improvement projects
- Produce a higher quality, more efficient transportation product

VE programs have produced numerous benefits<sup>1</sup> for transportation development across the United States:

- VE study recommendations typically result in a total project savings of about 10 percent, and five percent of project construction costs.
- Collectively, state departments of transportation (DOTs) implement approximately half of all VE recommendations.
- For every dollar spent on VE analysis, agencies realize about a \$150 return on investment.

Per [Code of Federal Regulations \(CFR\) 627.7](#), state DOTs must establish and sustain a VE program. NMDOT's VE program is managed by NMDOT's Engineering Support Manager.

## **220.2 References**

### **220.2.1 Federal Laws and Codes**

- [23 United States Code \(USC\) Part 106\(e\)](#) Value Engineering Analysis, (f) Life-Cycle Cost Analysis, and (g) Oversight Program.
- Federal Highway Administration (FHWA) [Value Engineering Final Rule](#), 23 CFR Part 627, FHWA-2013-0039, September 5, 2014.

### **220.2.2 Design Guidance**

- [Guidelines for Value Engineering](#), Third Edition, American Association of State Highway and Transportation Officials (AASHTO), 2010.
- [Value Engineering Circular A-131](#), Office of Management and Budget, May 21, 1993.
- [Value Engineering Policy Order 1311.1B](#), FHWA, August 28, 2013.
- [Value Engineering Requirement for Federal-Aid Projects](#), FHWA.
- [Value Engineering Resources](#), FHWA.

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<sup>1</sup> Presentation titled "Overview of Changes to FHWA's Value Engineering Regulation", FHWA, Ken Leuderalbert, October 2014.

## 220.3 Definitions

The definitions below are from [23 CFR Part 627.3](#):

- **Bridge project** - A bridge project shall include any project where the primary purpose is to construct, reconstruct, rehabilitate, resurface, or restore a bridge.
- **Final design** - Any design activities following Preliminary Design, expressly including the preparation of final construction plans and detailed specifications for the performance of construction work.
- **Project** - Any undertaking eligible for assistance under Title 23 of the USC. The limits of a project are defined as the logical termini in the environmental document and may consist of several contracts, or phases of a project or contract, which may be implemented over several years.
- **Total project costs** - The estimated costs of all work to be conducted on a project including the environmental, design, right-of-way, utilities, and construction phases.
- **VE analysis** - The systematic process of reviewing and assessing a project, by a multidisciplinary team not directly involved in the planning and development phases of the project, that follows the VE job plan and is conducted to provide recommendations for the following:
  - Providing the needed functions and considering community and environmental commitments, safety, reliability, efficiency, and overall life-cycle cost.
  - Optimizing the value and quality of the project.
  - Reducing the time to develop and deliver the project.
- **VE job plan** - A systematic and structured action plan for conducting and documenting the results of the VE analysis. While each VE analysis shall address each phase in the VE job plan, the level of analysis conducted and effort expended for each phase may be scaled to meet the needs of each individual project. The VE job plan shall include and document the following seven phases:
  1. Information phase - Gather project information including project commitments and constraints.
  2. Function and analysis phase - Analyze the project to understand the required functions.

3. Creative phase - Generate ideas on ways to accomplish the required functions which improve the project's performance, enhance its quality, and lower project costs.
4. Evaluation phase - Evaluate and select feasible ideas for development.
5. Development phase - Develop the selected alternatives into fully-supported recommendations.
6. Presentation phase - Present the VE recommendation to the project stakeholders.
7. Resolution phase - Evaluate, resolve, document, and implement all approved recommendations.

## **220.4 NMDOT VE Program**

The NMDOT has established a statewide VE program as required by [23 CFR Part 627.1\(b\)](#). A discussion of how projects are selected for a VE study is provided below.

### **220.4.1 Selecting Projects for VE Analysis**

#### **220.4.1.1 Requirements**

NMDOT may conduct a VE analysis on any project that may benefit from the exercise. In addition, NMDOT conducts VE analyses for all projects as required by the criteria set forth in Value Engineering Final Rule, [23 CFR Part 627](#), September 5, 2014. In accordance with these requirements, NMDOT conducts VE studies on the following:

- Each National Highway System (NHS) project with an estimated total project cost of \$50 million or more that uses federal-aid highway funding.
- Each NHS bridge project with an estimated total project cost of \$40 million or more that uses federal-aid highway funding.
- Any major project (project with a total estimated cost of more than \$500 million) on or off the NHS that uses federal-aid highway funding in any contract or phase comprising the major project.
- Any other projects the NMDOT Cabinet Secretary or FHWA determines to be appropriate.

VE analysis is most beneficial in the early stages of design - typically conceptual design through the completion of Preliminary Design. All projects shown in the Statewide Transportation Improvement Program (STIP) may be considered potential VE candidates. Individual screening is required to identify projects that may benefit the most from VE analysis. The following types of projects are often good candidates for VE analysis:

- Projects having more than one alternative solution
- Projects with relative complexity in the design
- Projects with a high degree of time compression in the planning and design phases
- Projects that incorporate innovative or alternative construction methods
- Projects that are controversial
- Projects that substantially exceed initial cost estimates
- Projects that evolved from simple to complex during the planning phase
- All major or unusual bridge structures
- Projects with complicated or costly maintenance of traffic requirements
- Projects specifically requested for VE study by NMDOT management staff, including the Districts

Other special studies should also be considered for VE. Topics for these studies may be chosen by soliciting ideas from management, the Districts, planning, design, construction, and operations personnel. One method of selecting study topics is to identify where the most expenditures are being made. Another area that should be considered are repetitive processes such as the use of NMDOT's specifications, standard sheets, standard details, etc.

NMDOT's Engineering Support Manager, in consultation with the District Engineers, will evaluate the STIP each fiscal year, along with a project status report, and prepare a list of candidate projects for VE studies.

From the list of candidate projects, a fiscal year VE Work Program will be established. The program will be submitted to the Chief Engineer or Designee for review and approval. The final program will then be distributed to staff for implementation.

Factors that are significant to the annual Work Program are:

- The annual VE Work Program should become effective and valid on the first day of each new fiscal year.
- The project identification, selection and scheduling process should be initiated by the Engineering Support Manager two months before the end of the current fiscal year with the final VE Work Program approved by the beginning of the fiscal year. Selection could also be made from the STIP.
- The annual VE Work Program should be updated quarterly by the Engineering Support Manager.

A Project Development Engineer (PDE), through the appropriate Bureau Chief or District office, may pursue an exception for not using the VE process on a specific project that does not require VE analysis per FHWA's regulations. A PDE may pursue an exception by submitting written justification to the Engineering Support Manager for consideration and approval by the Director of Engineering and Design. The final program will be included in NMDOT's VE reporting.

#### **220.4.1.2 VE Analysis Timing**

Timing is very important to the success of the VE analysis. A VE analysis should be conducted as early as practicable in the planning or development of a project, preferably before the completion of Preliminary Design.

The VE analysis should be closely coordinated with other project development activities to minimize the impact approved recommendations might have on previous agency, community, or environmental commitments; the project's scope; and the use of innovative technologies, materials, methods, plans, or construction provisions.

Benefits can potentially be realized by performing a VE analysis at any time during project development; however, the NMDOT performs VE studies early in project development during the

scoping/conceptual design phase and the Preliminary Design phase. The NMDOT may choose to conduct a VE study at other stages of project development if it is thought that a VE study would address key issues that have developed through the design process.

### **Scoping/Conceptual Design Phase**

VE studies completed in this early phase have the highest potential for the implementation of VE recommendations. For NMDOT projects, VE studies should be completed during Phase IA or during preparation of the Scoping Report. A VE study can be conducted on a project as soon as preliminary engineering information is available, specific project deficiencies or drivers are identified, and the project scope and preliminary costs are under consideration. When conducting a study during the scoping phase of a project, the VE analysis focuses on issues affecting project drivers. This stage often provides an opportunity for building consensus with stakeholders. A VE review during the scoping/conceptual design phase of a project would examine initial concepts by analysis of items such as:

- Safety records of the existing facility
- Right-of-way impacts
- Traffic projections and efficiency of traffic flow as measured by a capacity analysis in the design year
- Previously identified corridors or new corridors
- Environmental impacts
- Developmental issues and impacts
- Business and property owner impacts
- City and/or county comprehensive plans
- Pavement design
- Design life of proposed improvements
- Service life of existing facilities
- Utility relocations
- Maintenance of traffic
- Proposed typical section
- Right-of-way costs

- Construction cost estimates
- Maintenance cost
- Vertical alignment
- Horizontal alignment
- Proposed structures
- Stormwater retention plans
- Mitigation plans

### **Preliminary Design**

At the start of design, the project scope and preliminary costs have been established, preliminary design work is underway, and coordination has been initiated with the various service units that will be involved with the design. At this stage, the established project scope, preliminary costs, and schedule will define the limits of the VE analysis and there is still opportunity for the study to focus on the technical issues of specific design elements.

In addition to the previously outlined issues for the scoping/conceptual design phase, the team may also include the following items in the VE study:

- Excavation
- Traffic control devices and signing
- Structure type
- Pavement design
- Structure limits
- Material types and availability
- Drainage system
- Embankment and soil stabilization
- Constructability
- Retaining walls
- Median barriers and treatment
- Roadside safety treatment
- Shoulder and slope paving
- Milling

- Salvage values, including service life
- Roadway lighting
- Stormwater retention design

#### **220.4.2 VE Study Team Members**

An integral part of NMDOT's VE program is the selection of VE study team members. Team members should be selected for the various areas of expertise required for VE studies. Team member selection should be based on both VE experience and other transportation-related experience. Team members may include NMDOT employees, FHWA staff, and consultants. The best situation is to find the most qualified and most appropriate individuals with the best suited expertise on a VE team.

For teams that include NMDOT staff, the Engineering Support Manager will consult with the selected individual's supervisor(s) to arrive at a mutual agreement as to the individual's availability to participate in the VE study. VE study team members must meet the following minimum requirements:

- The VE study team shall be a completely independent, multidisciplinary team composed of members who have no previous involvement with the project, in accordance with [23 CFR 627.9 \(e\)\(1\)](#). It is recognized that the VE study team may need to obtain project design decision information from various design team members; therefore, the VE study team shall consult with the PDE and design team members as necessary.
- All VE teams should include members with the appropriate expertise from the NMDOT, FHWA, and qualified consultants. VE study teams may be comprised entirely of NMDOT staff; a mix of NMDOT staff, FHWA staff, and consultants; or entirely consultants. The composition of the VE study team will depend on many factors including staff availability and the expertise needed to conduct the VE study.
- All VE team members must have had VE training. The Engineering Support Manager will prepare and keep current a list of candidate VE study team participants who have participated in previous VE studies and have been trained in the Society of American Value Engineers (SAVE) 40-hour VE

certification workshop and/or the 32-hour National Highway Institute (NHI) VE workshop.

#### **220.4.2.1 Selecting a Team Leader**

The most critical factor governing the success or failure of a VE study team is the effectiveness of the team leader. Success is highly dependent upon the team leader's ability to create an open and free-flowing forum for the exchange of ideas and concepts. To do this, the team leader must be familiar with both the VE process and group dynamics. The VE team leader should be selected, in part, for his or her compatibility with the project to be studied.

A VE team leader will be assigned to each study by the Engineering Support Manager. The team leader may be a NMDOT employee or a consultant. Each team leader shall meet the following minimum standards:

- A NMDOT team leader must be a registered Professional Engineer (P.E.); have served on at least two studies as a team member; have completed the SAVE 40-hour VE certification workshop and/or the 32-hour NHI VE Workshop; have completed a team leader training course; have technical skills specifically related to the project being studied; and have participated on a VE study team or refresher course within the past two years.
- Each consultant team leader shall be a Certified Value Specialist (CVS) and a registered P.E. in New Mexico with at least 10 years full-time experience related to roadway or bridge design and/or maintenance.
- The team leader should have the sole responsibility for conducting the VE study in accordance with NMDOT's VE policies and procedures.

#### **220.4.3 Scheduling VE Studies**

Another important aspect of an effective VE program is ensuring proper scheduling after the annual VE Work Program has been approved. The first step in the process is to notify the respective PDEs that their projects have been selected for a VE study. The second step is for the PDE and the NMDOT's Scheduling Engineer

to include sufficient time in the project schedule to allow for the VE study. The duration to be allocated for the VE study is important to the overall project schedule. There is no specific duration that must be allowed for VE studies; however, the national norm is about five days (40 hours) for a typical study, plus additional time to prepare for the VE study and arrive at final decisions for implementation.

A typical VE study schedule is provided below:

- Week 1 - Perform VE study
- Weeks 2 and 3 - Prepare VE study report and submit for review
- Weeks 4 and 5 - Review the VE study report. The review team typically includes the NMDOT PDE, design team members, and the VE study team.
- Week 6 - VE study team submits recommendations to the PDE

#### **220.4.4 NMDOT Statewide VE Program Reporting**

It is important for the NMDOT to report on VE studies conducted by the NMDOT. This serves to meet FHWA requirements; ensure continued support by demonstrating that the NMDOT is producing cost-effective projects; and foster a better understanding, appreciation, and acceptance of the VE process.

In order to accomplish reporting objectives, the NMDOT shall develop and distribute a report following each VE analysis. This report should contain the following information:

- The number of VE recommendations
- The percent of recommendations implemented
- The number of, and reasons why, recommendations were not implemented
- Potential savings of VE recommendations
- The savings of VE recommendations that were implemented
- Reasons for rejecting VE recommendations
- VE cost reduction proposals received
- VE cost reduction proposals rejected and reason for rejection
- VE cost reduction proposals approved and value of the approved savings

- Other special studies begun
- Other special studies completed, including the value of approved recommendations and the reasons for rejected recommendations

## 220.5 NMDOT VE Procedure

### 220.5.1 VE Procedure Overview

VE analysis uses the study phases discussed in [23 CFR 627.3](#) and listed in Exhibit 220-1.

**Exhibit 220-1  
VE Study Phases**

VE Study Phase	Work Plan
1. Information Phase	Gather project information including project commitments and constraints. <ul style="list-style-type: none"> <li>• Investigate technical reports and field data.</li> <li>• Develop team focus and objectives.</li> </ul>
2. Function Analysis Phase	Analyze the project to understand the required functions. <ul style="list-style-type: none"> <li>• Define project functions using active verbs and measurable nouns.</li> <li>• Review and analyze these functions to determine which need improvement, elimination, or creation to meet project goals.</li> </ul>
3. Creative Phase	Generate ideas on ways to accomplish the required functions that improve project performance, enhance quality, and lower project costs. <ul style="list-style-type: none"> <li>• Be creative.</li> <li>• Brainstorm alternative proposals and solutions to lower project costs, improve project performance, and enhance quality.</li> </ul>
4. Evaluation Phase	Evaluate and select feasible ideas for development. <ul style="list-style-type: none"> <li>• Analyze design alternatives, technical processes, and life-cycle costs.</li> </ul>
5. Development Phase	Develop the selected alternatives into fully supported recommendations. <ul style="list-style-type: none"> <li>• Develop technical and economic supporting data to prove the benefits and feasibility of the desirable concepts.</li> <li>• Develop team recommendations (both long-term and interim solutions).</li> </ul>
6. Presentation Phase	Present the VE recommendation to the project stakeholders. <ul style="list-style-type: none"> <li>• Present the VE recommendation to the project team and region management in an oral presentation.</li> <li>• Provide a written report.</li> </ul>
7. Resolution Phase	Evaluate, resolve, document, and implement all approved recommendations.

### 220.5.2 Pre-Study Preparation

NMDOT’s annual VE Work Program is developed by the Engineering Support Manager. Once a VE study has been identified, PDEs should work with the Engineering Support

Manager to schedule the VE study and identify the VE study team. Once the schedule and study team are established, the objectives of the VE study should be established identifying the aspects of the project that will be studied. At that point, the design team should prepare a study package of project information for each of the VE study team members. The VE team members should receive this information at least one week prior to the VE study so they have time to review the material.

### **220.5.3 VE Study Reporting Requirements**

Once the VE study is conducted, a VE study report must be prepared. Typically a draft report is sent for review by the VE study team, the PDE, and the design team. Once comments are received, the draft report is finalized. The VE study report includes the following:

- An executive summary
- A narrative description of project information
- Project background, history, constraints, and controlling decisions
- The VE team's focus areas
- A discussion of the VE team's speculation and evaluation processes
- The VE team's final recommendations

All of the team's evaluation documentation, including sketches, calculations, analyses, and rationale for recommendations, is included in the final report. A copy of the final report is to be included in the project file, and it must be provided to the Engineering Support Manager. The Engineering Support Manager will provide a copy of the final VE study report to the FHWA, when applicable.

Post-VE study activities include:

- Implementing and evaluating the approved recommendations and their outcomes
- Documenting the reasons that any approved recommendations were not implemented

These post-analysis activities are conducted prior to the final design phase to ensure the recommendations are included in the final design or the reasons for not implementing the recommendations are included in the design documentation.

#### **220.5.4 Implementing VE Recommendations**

Once the draft VE study is available, the Engineering Support Manager (in consultation with the Chief Engineer) shall establish the VE Implementation Committee. The VE Implementation Committee is responsible for objectively evaluating the VE study team's recommendations. Committee members should disqualify themselves from the review if they have been involved in the project design. The committee should be made up of individuals selected from a pool based on the size and importance of the project being reviewed. The pool should include the following NMDOT positions or their designees:

- Chief Engineer
- Engineering Support Manager
- Regional Design Managers from the North, Central, and South regions
- District Engineers
- State Bridge Engineer
- Drainage Design Bureau Chief
- State Traffic Engineer
- State Construction Engineer
- Project Development Engineer
- Right-of-Way Manager
- Environmental Bureau Chief
- State Materials Engineer
- State Maintenance Engineer

All VE study recommendations should be reviewed by the Engineering Support Manager for general conformity. Once VE study recommendations are completed, they shall be forwarded to the VE Implementation Committee and the PDE. The PDE shall

review the recommendations in consultation with the design team, and provide comments to the VE Implementation Committee.

The VE Implementation Committee shall be required to justify rejecting any VE recommendations to the Chief Engineer or Designee, who shall have the final authority for rejection or approval of VE recommendations. The assigned Implementation Committee should attend the VE team presentation.

## **220.6 VE Cost Proposal**

The NMDOT's VE cost proposal protocol for contractors is included in Section 104.8 of NMDOT's Standard Specifications for Highway and Bridge Construction. Including it as a standard specification is in alignment with several other state highway agencies. The Construction Bureau shall report all cost savings that are the result of any VE cost proposal to the Engineering Support Manager as they occur. Coordination, final approval, and reporting responsibilities shall be shared by both the Engineering Support Manager and the Construction Bureau.

## **220.7 Documentation**

The following reports serve to document the VE Process:

- VE study package
- VE study report (draft and final)
- VE implementation committee findings
- VE cost proposal