Value Engineering (VE) in Design-Build: A Value Management Approach

The Number One Reference Document for Professionals & Students Researching the Basic concepts and Key Elements of the Design-Build Industry.

An Official DBIA Manual of Practice Chapter
Table of Contents

1 | Introduction/Overview ................................................................................................................. 3

2 | Key Issues/Considerations ............................................................................................................ 4

3 | Best Practices ................................................................................................................................. 8

4 | Expectations ................................................................................................................................. 13

5 | Summary ...................................................................................................................................... 15
1.0 Introduction

The following discussion provides general guidelines for including Value Engineering (VE) within design-build project delivery. Application of the VE process in this context will include the design-builder. The sections herein define VE and describe its process, merits, and benefits in the context of design-build. The options and opportunities for VE implementation take into account diverse owner goals and the differing procurement laws that define procurement possibilities. The formal VE studies addressed in this guide are the structured implementation of focused VE events by trained facilitators during the course of a design-build project. All participants in a design-build project should incorporate the underlying VE concepts and tenets throughout the planning and execution of the project.

The Value Methodology

Value Methodology (VM) is an organized system of investigation using trained multi-disciplined teams to analyze the requirements of a project for the purpose of achieving its essential functions at the lowest total cost (capital, operation, and maintenance) over the life of the project.

Improved Value

Virtually all projects have opportunities for improved value, and the VE process has the objective of identifying those opportunities. Value is proportional to the ratio of function over cost, where a project’s function is defined as what it is expected to do.

\[ \text{Value} = \frac{\text{Function}}{\text{Cost}} \]

Alternatively, the term “performance” can be used instead of the term “function.”

Value is achieved by improving function and maintaining cost; by maintaining function while reducing cost; or by improving function while reducing cost. VE can be defined as an analysis of a project’s functions directed at improving performance,
reliability, quality, safety, and life-cycle cost.

**Applicability of Value Engineering**

Owners who derive benefit from a VE evaluation of their projects include both public (county, city, state, and federal, including the military) and private sector entities. Project types can include any facility or structure type, such as bridges, highways, buildings, hospitals, schools, court facilities, mass transit facilities, water treatment plants, and marine facilities. VE is currently used by the U.S. Military and by many agencies at all levels of government, including federal, state, and local.

**Why Use VM/VE?**

<table>
<thead>
<tr>
<th>Capital Cost</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life-Cycle Cost</td>
<td>Value</td>
</tr>
<tr>
<td>Design-Time</td>
<td>Profitability</td>
</tr>
<tr>
<td>Decision Time</td>
<td>Ideas</td>
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**2.0 Key Issues**

**Overview**

The basic phases of a VE study include:

*Information Phase:*

Gather information about the project.
Function Analysis Phase:
Identify basic project functions and goals.

Creative Phase:
Formulate project alternatives.

Analysis Phase:
Evaluate project alternatives.

Evaluation Phase:
Develop best alternatives.

Presentation Phase:
Present recommendations.

Implementation Phase:
Incorporate suggestions into the project.

Study Features

VE studies identify project issues and provide opportunities to optimize the design in progress while validating project scope, budget, and costs. Activities undertaken during VE studies include:

- Understanding project criteria.
- Identifying appropriate project scope.
- Validating project initial cost and budget.
- Ascertaining best value alternatives.
- Evaluating life cycle costs.
- Identifying and evaluating risk.
- Assessing the schedule.
- Reviewing constructability.
- Evaluating contract/procurement options.
• Minimizing change orders during construction.

Cost reduction as a standalone issue is not part of the VE process. Reduction in cost is often an outcome of the process, although it is never achieved by sacrificing functions essential to project success.

**Team Formation**

Formal VE studies should be lead by a trained facilitator (e.g., Certified Value Specialist – CVS). Studies are most successful when qualified individuals from a range of disciplines and backgrounds are included in the team to achieve an optimum combination of perspectives, owner requirements, project goals and constraints, and independent technical input.

Collaboration between owner and independent team members will encourage diversity and independence of thought. An advantage of the integrated team is that the potential for organizational constraints can be overcome. Teams totally or mostly composed of owner representatives are generally more constrained by policy, politics, guidelines, standard practice, and regulations.

**Implementation of Value Engineering**

![Pareto's Law of Distribution](image_url)

*Pareto’s Law of Distribution*

- **Total Cost (percentage)**
- **Number of Components (percentage)**

*VE in DB*

*Focus on major cost items*
**Design-Bid-Build**

The VE process does not change based on the project delivery method. In the standard design-bid-build scenario, the VE study (or studies) can be performed at any time during the project delivery process, starting with scoping/planning and continuing through various stages of design completion. Pareto's Law of Distribution presented by the graph on the previous page shows that a limited number of project elements correlate to a majority of project cost. The VE study will generally focus on major project components as it determines best value.

**VE at Planning/Scoping.** Define project budget and parameters.

**VE at 0% Design.** Identify project requirements and issues.

**VE at 15% Design (Schematic).** Validate and refine project concept and cost.

**VE at 30% Design.** Evaluate major systems and refine cost.

**VE at 60% Design.** Refine systems, cost, and constructability.

As the design and project schedule advance, each successive study performed offers a slightly different focus. Typically,
the earlier the study occurs, the greater the potential benefit. Owners may elect to contract for only one study or to have multiple studies performed in response to project complexity or cost.

**Design-Build**
Design-build is a project delivery method in which design and construction are provided from a single source. Since VE optimizes design and promotes project value, construction through the design-build project delivery method is compatible with the goals of VE. Furthermore, VE will augment the benefits of design-build, since its focus extends beyond cost-cutting and creativity in construction.

### 3.0 Best Practices

**Implementing Value Engineering in Design-Build**

There are numerous options and opportunities for implementing VE during the evolution of any project, and there is no single best methodology for all owners. Owners should evaluate all implementation options to find the most appropriate in terms of in-house manpower, expertise, available time, budget, and legal procurement constraints. Owners are encouraged to implement VE and consider which type of VE study to implement, when to implement it, and how many technical experts to include on the VE team.

Performing a VE study subsequent to design-builder selection provides an opportunity to include the contractor in the VE process — one that can never happen during standard design-bid-build. A VE study can be performed prior to the issuance of the RFP, similar to a standard procurement. An additional VE study, subsequent to selection of the design-builder but prior to the Notice to Proceed, will benefit from contractor participation.

**Study Options**

**Option 1: During Planning/Scoping**

**Purpose:** Scope Validation
Funding: Owner
Duration*: 1 Week (Max.)
Participants: O, F, E
End Product: Scope & Budget

Option 2: During Draft RFP
Purpose: Review RFP/Refine Requirements
Funding: Owner
Duration*: 1 Week (Max.)
Participants: O, F, AE1
End Product: RFP

Option 3: After Selection, Before NTP
Purpose: Finalize Scope/Price
Funding: Owner
Duration*: 1 Week (Max.)
Participants: O, F, AE1, D-B (& AE2)
End Product: Contract and Price

O = Owner
AE1=Owner’s Designer
AE2=Design-Builder’s Designer
F = Trained Facilitator
E = Experts
D-B = Design-Build Team

*Duration: 40-hour maximum workshop, excluding time for pre-study, site visits, or post-workshop report preparation.

Study Descriptions

Option 1: During Planning/Scoping
Owners have their own methodologies for project need identification and budgeting. For certain high-profile, politically sensitive, high-cost projects, it could prove beneficial to seek additional input to review issues including the schedule, contract provisions, design and construction alternatives, and the budget.

**Option 2: During Draft RFP**
Performing VE studies prior to issuing RFPs to shortlisted design-build teams is similar to performing VE studies within the standard design-bid-build procurement process. VE studies at this point review project design and RFP documents including performance requirements for consistency and effectiveness. All accepted recommendations are included in the RFP package. Costs for VE studies performed prior to the issuance of RFPs are borne by the owners.

**Option 3: After Selection, Before NTP**
VE Studies held after the selection of the design-build team but prior to issuing a Notice to Proceed include the owner, AE1, the VE team (the trained facilitator and technical experts), and the design-builder, including AE2. The VE team reviews the design-builder’s project approach, upon which they based their bid. The VE process also provides a forum for the design-builder to question and/or provide alternatives to the stipulations contained in the RFP.

The timeframe for performing VE studies after selection but prior to proceeding is critical; the design-builder should not be penalized with regard to the schedule. Recommendations stemming from a study at this point in the project should only be implemented upon the concurrence of the owner and design-builder. Unilateral decisions by the owner should be avoided so that the owner and design-builder maintain their respective share of risk, and the design-builder is not forced to construct a project inconsistent with his experience or desired approach.

Improvement in project value can result from either a cost reduction or a cost increase if performance is enhanced. In the event of a cost reduction, it is recommended that the owner and design-builder share such savings, similar to a Value Engineering Change Proposal (VECP) submitted by a contractor during construction. Structure in the contract to share all savings experienced during performance, including those resulting from VE cost reductions, is a design-build best practice. Any changes during the VE process will not affect the construction schedule, since they occur prior to the issuance of a Notice to Proceed. The design-builder is thus motivated to participate in the VE process and will not hold back for potential future considerations. The percentage sharing of VE savings is determined by the

*Structure in the contract to share all savings experienced during performance... is a design-build best practice.*
owner, although the split should be sufficient to engage the cooperation of the design-builder. Equal sharing of cost savings is likely to serve as an incentive to the design-builder.

Should a recommendation or set of recommendations lead to a cost increase, the cost would be added to the design-builder’s bid price, since the owner is deriving the full benefit from the change.

The cost for the VE study in Option 3 is borne by the owner. Funding for the study can be included as a “fixed add cost” in the design-builder’s initial bid. As a variation, the owner may also require that the cost of the VE study be reimbursed from implemented project cost savings and the additional savings then shared between the owner and design-builder.

**Partnering**

The process described above represents a true partnership between project participants, as both the owner and design-builder have the same goals, although perhaps due to different motives.

Implementing VE in design-build subsequent to contractor (DB) selection furthers partnership goals by:

- Creating an effective project team
- Developing project consensus
- Establishing open lines of communication
- Promoting group synergy

**Risk**

Compared to the design-bid-build scenario, in design-build project delivery the design-builder takes on significantly more risk by committing to an early bid price. The construction price is developed from “baseline” design criteria and project performance requirements prepared and established by the owner, combined with the design-build team’s own design development, which is significantly less than a 100% complete set of documents. Other protocols used throughout the industry as the basis for the design-build bid include a “standard design,” or requesting a complete performance design based upon given criteria. The risk assumed by the design-builder remains higher than in a design-bid-build scenario.
A VE study performed prior to the release of the baseline RFP package will help manage the owner’s quantifiable risk prior to involvement of the design-builder. The study will identify issues of concern and develop alternative solutions to address those concerns.

A VE study held in conjunction with the design-builder after its selection will help in managing risk for both the owner and the design-builder. A study at this point will reduce the possibility of future claims by the design-builder, since there is an opportunity to clarify project issues and modify stipulations early on in the project. The design-builder’s participation in the VE study will ensure a more even sharing of project risk with the owner.

**Life-Cycle Cost Analysis**

The life-cycle cost, or total project cost over the useable life of a facility, equates to the initial capital cost plus future operation and maintenance costs. The owner should not underestimate future cost during project scoping and design; VE can be a useful tool in specifically addressing and estimating total project cost.

Projects that forego the VE process rely upon the designer’s estimate of total project cost. Life-cycle cost is usually addressed by an owner requirement to design a facility for a specified useable life. Designers rarely perform a formal life-cycle cost analysis, and instead use their experience and best judgment to estimate total cost. VE studies during the early stages of design prior to issuance of the RFP will help identify structure types, materials, finishes, and equipment
or systems that require future cost to maintain function.

As long as the project requirements presented within the terms of the RFP are not violated (minimum condition met), the design-builder is generally not concerned with life-cycle costs. VE within design-build procurement provides another opportunity to address these issues. When the design-builder participates in a VE study with the owner and designer, the issues associated with life-cycle cost and best value can be revisited to assure that the owner’s interest in long-term viability and cost control are adequately addressed by the design solution.

4.0 Expectations

Study Deliverables

The typical VE study will provide the owner between 40 and 60 recommendations spanning various project categories or disciplines, including:

Sample Categories of Recommendations:
- Geotechnical/Foundation
- Site/Utilities
- Environmental/Permitting
- Architectural
- Structural
- Electrical/Power
- Mechanical/Plumbing/HVAC
- Security
- Specialty Equipment

Sample Issues Addressed:
- Project Scope
- Design Criteria
- Design Standards
- Alternative Construction
Many of the VE recommendations will have cost implications, either adding or reducing cost in the quest for best value. Some of the suggestions will be compatible with one another, while some will be exclusionary, meaning that not all recommendations can be implemented. The owner and/or team participants will determine which of the recommendations to carry forward and incorporate into the project.

**Cost Savings/Avoidance**

Various agencies have documented cost savings from their VE programs, wherein construction cost reductions of well over 5% on the baseline project cost estimate are common. The return on investment (ROI), or the cost of the VE study/cost savings, is related to the construction cost of a project, since the cost of the VE study is relatively stable. A ROI of over 100:1 is documented by some owners.

Table II depicts a statistical sampling of the VE programs for one federal agency, one state agency, and one city agency. The agencies themselves furnished the information.
VALUE ENGINEERING (VE) IN DESIGN-BUILD: A VALUE MANAGEMENT APPROACH

Table II. VE Study Statistics

<table>
<thead>
<tr>
<th>AGENCY:</th>
<th>FHWA</th>
<th>CALTRANS</th>
<th>NYCOMB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years:</td>
<td>‘01–’04</td>
<td>‘03</td>
<td>‘00–’04</td>
</tr>
<tr>
<td>No. of Studies:</td>
<td>1388</td>
<td>not applicable</td>
<td>61</td>
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<tr>
<td>Study Cost:</td>
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<td>$1.9 M</td>
<td>$1.4 M</td>
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<td>Baseline Estimate:</td>
<td>$78.7 B</td>
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<td>$18.2 B</td>
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<tr>
<td>Cost Reduction:</td>
<td>$4.1 B</td>
<td>$0.2B</td>
<td>$1.1 B</td>
</tr>
<tr>
<td>% Cost Reduction*:</td>
<td>5.2%</td>
<td>7.8%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Return on Investment</td>
<td>127:1</td>
<td>105:1</td>
<td>109:1</td>
</tr>
</tbody>
</table>

FHWA = Federal Highway Administration; Caltrans = California Department of Transportation; NYCOMB = New York City Office of Management and Budget

* The dollar amounts shown are the sum of cost reductions and cost increases from accepted recommendations. Implementation of study recommendations historically tend to reduce project cost, but may also add cost if the proposed benefits (value added) outweigh added expenditure.

5.0 Summary

The VE process is pertinent to the evaluation of any project type by any owner (public or private) and the earlier a VE study is performed, the greater the potential benefits. It has positive impact on a project when studies are performed during design for a standard design-bid-build scenario, and even more so for a design-build delivery as the design-builder becomes integral to the process.

Benefits of Value Engineering in Design-Build
In conclusion, implementing VE within the design-build process provides the following benefits:

- Generate cost shared savings for both the owner and the design-builder.
- Spurs innovation in construction, since the terms of the owner’s RFP may be re-evaluated or modified.
- Minimize risk to both the owner and the design-builder due to the consensus approach to the project.
- Increase likelihood that the resulting project will satisfy owner and user needs.

DBIA thanks SAVE International for their contributions to this chapter. DBIA promotes the value of design-build project delivery and teaches the effective integration of design and construction services to ensure success for owners and design and construction practitioner.

SAVE International is the international society devoted to the advancement and promotion of the value methodology (also called value engineering, value analysis or value management). Value methodology benefits include decreasing costs, increasing profits and improving quality.