Bulletin No. JM 17
File: Job Management

Bulletin

Value Engineering

The MCAA Management Methods Committee wishes to thank Team 3 of the Advanced Leadership Institute's Class 17 for providing the content for this bulletin. **Members of Team 3 include: David Carter of Harris Companies; Bryan Gilbert of EMCOR Services Mesa Energy Systems; Stu Hudson of JH Kelly, LLC; Kourtney Mierzejewski of J.C. Cannistraro, LLC; Dan Reuter of Binsky & Snyder, LLC; and Brandon Wikoff of U.S. Engineering Company.**

INTRODUCTION

In its broadest terms, Value Engineering (VE) is a systematic and structured process intended to improve the value of the products, projects or processes by improving the performance of the functions the customer needs at the lowest lifecycle cost. ***In short, Value Engineering is an approach to optimizing value for each dollar spent.***

It is imperative that the function of the owner's design is not mitigated during this process. Simply reducing cost at the expense of the quality is not value engineering, but rather cost cutting. It is a VE principal that the overall function be upheld and not be reduced during the pursuit of value improvements.

The idea of VE was first introduced after World War II by Larry Miles, who is considered to be its father. He identified two elements of the value equation—function and cost—and balanced them against one another to quantitatively analyze the VE process. His equation was:

$$\text{Value} = \frac{\text{Function}}{\text{Cost}}$$

Function is the specific work that a design/item must perform.

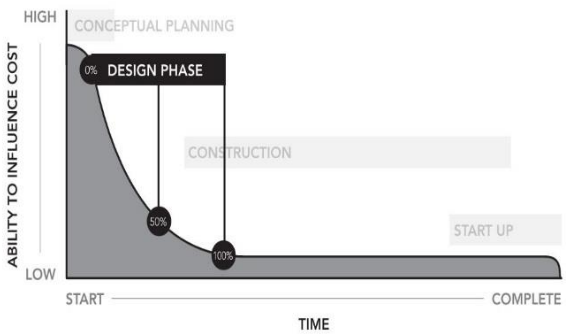
Cost is the life cycle cost of the product.

Value is the most cost-effective way to reliably accomplish a function that will meet the user's needs, desires, and expectations.

Therefore, VE can be increased by increasing the function of the item, lowering the cost of the item, or both.

PROCESS

According to the Society of American Value Engineers Value Standard, the practice of value engineering will follow six phases. The ability to influence project cost drops exponentially after the first 10% of design is complete. It becomes negligible at 100% design. Ideally, the owner will seek early involvement of the construction partners to allow the most collaborative effort between the entire project team including the owner, architect, engineer, general contractor (or construction manager) and subcontractors.



However, the following six phase approach should take place whenever VE is being evaluated, keeping in mind that the term "project team" should include the owner. Their participation in all six phases results in the highest level of targeted, effective solutions.

1. **Information Phase**

   It is important to take the proper time and resources for all members of the VE team to understand the background and decisions that have shaped the current state of design. The team should also clearly define the owner's definition of value on the project and his objective at the result of the process.

2. **Function Analysis Phase**

   This analysis will identify the areas of the project that should be included in the study. Once identified, the VE team should review and analyze each function and determine how it impacts the overall project design. Each of these areas should be examined to determine which need improvement, elimination, or creation to meet the project goals.

3. **Creative Phase**

   This phase of the process allows the entire project team to brainstorm all possible ideas that could increase the value of the project based on the parameters established in the analysis phase. Creative and innovative ideas are encouraged as well as any new and interesting ways to perform the project function differently. At this point, rough-order magnitude pricing should be established for each VE idea. This requires participation from each project team member, including the GC (or CM), subs and the design team. Any potential schedule impacts should be identified along with initial cost, future maintenance and Life Cycle Cost Analysis (LCCA) related to energy and equipment replacement. The intent of estimating a LCCA is to give the owner as much information as possible to make the best decision for their business needs. In some cases, such as a developer looking to flip a building with no interest other than initial cost, LCCA may not be required.

4. **Evaluation Phase**

   During this phase, the project team should follow a structured evaluation process that narrows the initial list to a smaller list that offers the potential for value improvement. It is important that each idea selected maintains the project's functions and considers the performance requirements and resource limits. This is a good opportunity to refine the initial and life cycle cost impacts of each VE idea.

5. **Development Phase**
   At this stage, the project team will expand on the final list of options previously chosen. Sufficient detail should be added and enough documentation provided that allows the appropriate decision makers the ability to determine if the alternate ideas should be implemented.

6. **Presentation Phase**
   In the final phase, the project team leader develops a report that provides sufficient information detailing the VE alternates. The report should communicate the adequacy of the alternates, including the function and cost specifics of each alternate. Any variance in schedule, future maintenance impact and overall life cycle cost differences, if applicable, should be communicated to the owner.

MECHANICAL CONTRACTOR

When a mechanical contractor is asked to participate in a Value Engineering process, its role and responsibilities will vary depending on the Project Delivery System. The most common are Design-Bid-Build or Design Build/Design Assist. Let's explore some of the differences and how they impact the mechanical contractor:

Design-Bid-Build
VE in a traditional Design-Bid-Build Project often involves the owner and General Contractor/CM-at-Risk receiving bids that sum to exceed the anticipated budget. This situation often occurs due to the lack of subcontractor involvement in the initial budgeting efforts. Ideally from an owner's perspective, the project design documents reflect the budget. However, final bids can exceed the target budget for many contributing factors such as: scope increases; missed labor or material cost projections; schedule issues; local labor market (availability); and changes to the construction environment since the original budget was created.

In this scenario, the mechanical contractor, along with all other subcontractors, is requested to provide a VE list that includes various options to reduce cost. A red flag should be raised if there is no discussion of function or intent between the construction team, but simply the owner asking for cost-cutting measures after the design is complete. A few examples of VE targets include material substitutes, construction methods and schedule. Routings and layout may be up for consideration, but often a completed architectural design will limit these opportunities for savings or betterments.

Functionally, the Design-Bid-Build VE method includes the use of pre-defined, boilerplate strategies that can be tailored to the project. Additional specifics outside of the boilerplate can be targeted based on the mechanical contractor's familiarization and knowledge of the project, means and methods, lead times or local labor uniqueness.

After the contractor provides its VE proposals, the Owner/GC would then be responsible for aligning the impact on other trades to get to an all-inclusive cost alternative. The decision to provide VE after the design is complete will limit the ability to provide value alternates and may increase the coordination impacts throughout the construction process. VE completed post-bid in a Design-Bid-Build project delivery system is the least ideal opportunity and use of VE.

Design Build/Assist
Conversely, Design Assist and Design Build projects present the best opportunity for an owner to gain the most value from

VE. The opportunities for a mechanical contractor to impact a project's financial position in a Design-Build format is very different than Design-Bid-Build. Unlike Design-Bid-Build VE where VE targets may only include materials substitutes, construction methods, schedule, routings and layout, the opportunity is available to influence design concepts and system selection.

Optimizing a project's value from its inception offers a wealth of opportunities for savings that can be realized throughout the expected life of the building or facility. Additionally, the opportunity to capture savings reduces rapidly as a project progresses through design. More specific examples include:

- Fabrication and advanced technologies;
- Detailed scheduling and planning;
- Ongoing "live" budgeting;
- Early coordination, constructability analysis and better planning;
- System selection with energy modeling and accurate pricing;
- Cost-based design management;
- Leading edge prefabrication, multi-trade and modular components; and
- Integrated Design – "draw once."

Design changes to alleviate an error or omission in the original design will cost significantly more during construction than the same change included in the original design phase. Catching this error early will provide increased savings to the owner and increased productivity to the contractors.

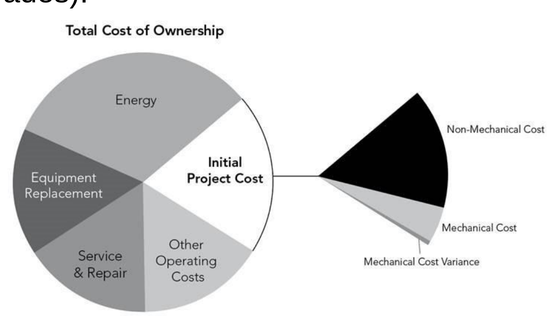
VE through early collaboration presents itself in the first 10% of design, right at the project inception. Only at this point on the project will a collaborative team have the influence required to bring maximum value. Recent Pennsylvania State University research compared collaborative Design-Build versus traditional Design-Bid-Build and found the following:

- Unit Cost: 6.1% lower
- Construction Speed: 12% faster
- Full Project delivery speed: 33.5% faster
- Cost Growth: 5.2% less
- Schedule Grow: 11.4% less

(https://www.dbia.org/resource-center/Documents/cii_penn_state_study.pdf)

VE opportunities are often lost due to schedule. Visualize a mechanical contractor offering a savings related to a complete systems change, yet the proposed system design was already at 100% completion. In this case, the VE opportunity is lost since the owner can't afford to lose the time required for a complete re-design.

Furthermore, owners are now seeing the impact that early collaboration has on the Total Cost of Ownership. Operational savings over the life of the building/facility will always dwarf the initial mechanical construction contract value. Energy, service and repair, equipment replacement, and other operating costs equate to multiple times the total contract value (total project cost including all trades).



BENEFITS AND DRAWBACKS

There are many other factors that a mechanical contractor should consider when deciding if it should adopt the Value Engineering process.

Client Relationship
A mechanical contractor that can provide the resources and energy to actively engage in a VE process will add tremendous value to its relationship with the client. The construction team requires active participation from all contractors and our clients know that the contractors that can participate in this exercise are essential to the practice.

Competitive Advantage
Those contractors that are prepared to engage in VE will have a competitive advantage to those contractors that will not or cannot participate. In addition, a significant and creative VE suggestion could be the difference required to win a job in a competitive bid environment.

Impact on the Design and Design Team
Value Engineering is not always seen as a positive development or experience by design professionals. This is mainly because the process can be initiated after the design is complete and be solely for cost-cutting of scope or programming as well as material or equipment sacrifices. This presents an increased risk for the performance or potential failure of the system over its lifetime.

Cautions
It is critical to ensure that the VE reduction in cost does not compromise the integrity of the design intent. Such compromises could risk design failures, decreases in efficiencies, or other changes to the design function that do not meet the owner's expectations.

It is essential that the customer is aware of the changes, the pros and cons of the change, as well as the reduction in cost.

Contract
It is also important that any changes to the design are clearly stated in the contract documents, drawings and specifications so there is no doubt as to the changes from the original design. In addition, the contract should clearly state the revised scope of work including exclusions, limitation of liability language and a limited warranty period to prevent a claim from occurring numerous years after providing the design or installation. This is to clearly demonstrate that all parties of the construction team; the owner, construction manager/general contractor, architect and design team are aware of the changes, understand the impact of these changes and approve or certify these changes.

CONCLUSION

A team oriented Value Engineering process will provide substantial benefits to all parties involved in the process. Through this process, contractors can provide an invaluable service to their clients thus increasing their value and competitive advantage. The design and construction team will foster a teamwork approach to the entire construction process, encountering fewer re-designs and a more efficient construction process. Lastly, the owner will be provided an improved, more cost-efficient project that meets all the construction objectives.

ADDITIONAL RESOURCE

SAVE International®
http://www.value-eng.org