# Finding Value in the Value Engineering Process

*Kristin E. Lane Davis, CCE*

ABSTRACT: The purpose of this article is to show how value engineering is clearly one feasible option for owners in dealing with funding projects in a constantly changing and volatile economy. In addition to providing the history and background on value engineering, the article will also outline the value engineering process. The reader will learn when is the best time to perform value engineering in the life of the project, the key to ensuring a successful value engineering study and why value engineering should be performed. Finally, the cost of applying this valuable tool is discussed in conjunction with data from real studies. The volatile economy has forced all parties, but especially owners, to seek every possible option to ensure that budgets are met and to justify funding for projects. Improvements in technology have allowed processes that were once burdensome and time-consuming to become more efficient.

KEY WORDS: Budgets, economy, life-cycle costs, productivity, and value engineering

The status of the economy is constantly changing. Major consolidation in the domestic steel industry, a shift in foreign exchange rates that spiked prices for imported materials, a ruling against the US in its trade dispute with Canada over lumber imports, and a shortage of natural gas threatening to push energy costs higher are just some of the factors currently effecting the construction industry and the economy as a whole.

Owners may find that funding for a project that was 60 percent into the design process has suddenly vanished. Contractors are faced with lumber prices that have suddenly doubled from when they bid the project. What does this mean for current and future construction projects?

The volatile economy has forced all parties, but especially Owners, to seek every possible option to ensure that budgets are met and to justify funding for projects. Improvements in technology have allowed processes that were once burdensome and time-consuming to become more efficient.

Likewise, increasing productivity has allowed companies to squeeze cost and rebuild their bottom lines. The continued surge in productivity is a key reason why profits have strengthened considerably in recent quarters even as growth remained tepid. Even now, pricing power remains nonexistent in many sectors, and capacity is excessive [2].

Even considering these two key factors, there are other, equally viable, solutions to ensuring that projects stay within budget. The purpose of this article is to show how value engineering is clearly one feasible option for owners. In addition to providing the history and background on value engineering, the article will also outline the value engineering process. The reader will learn when is the best time to perform value engineering in the life of the project, the key to ensuring a successful value engineering study and why value engineering should be performed. Finally, the cost of applying this valuable tool is discussed in conjunction with data from real studies.

For three years, the US has been besieged by falling stock prices, investor distrust, war, and economic uncertainty. The economy has made a slow recovery from the recession in 2001. In the construction industry, economists are forecasting that 2004 will be another year of slow economic growth (see Figure 1). McGraw-Hill Construction experts anticipate contract awards to increase only one percent to \$509 billion. The US Department of Commerce is predicting growth for construction put-in-place to be even more moderate. It forecasts only a 0.2 percent increase in total construction in 2004 after 2003's 1.5 percent increase [3].

Despite the bleak economic past, economists are optimistic about the future. Experts predict the overall economy will grow four percent next year, compared to this year's average 2.7 percent increase [3]. Other positive signs are increased commodity prices, increased manufacturing output, and the upswing in factory orders. Economic growth hit a staggering 7.2 percent in the third quarter and is expected to settle at four percent by year's end.

Growth in productivity is a key factor in the recovering economy. Increased productivity allows companies to cut cost and rebuild their bottom lines. Improvements in technology is the number one factor for the increase in productivity. However, other factors, such as benchmarking performance against comparable companies, outsourcing, use of temporary workers, and business process redesign have also played a significant role in driving up productivity rates [2].

As good as this sounds for the overall economy, the construction industry does not look as promising. Inflation-adjusted outlays for the construction of industrial and commercial buildings are 12.5 percent lower than one-year prior. Spending on new construction fell by a stunning 39.8 percent from 2001 to the end of 2002 [1]. Budgets are tight and owners are seeking ways to reduce cost. Although the main

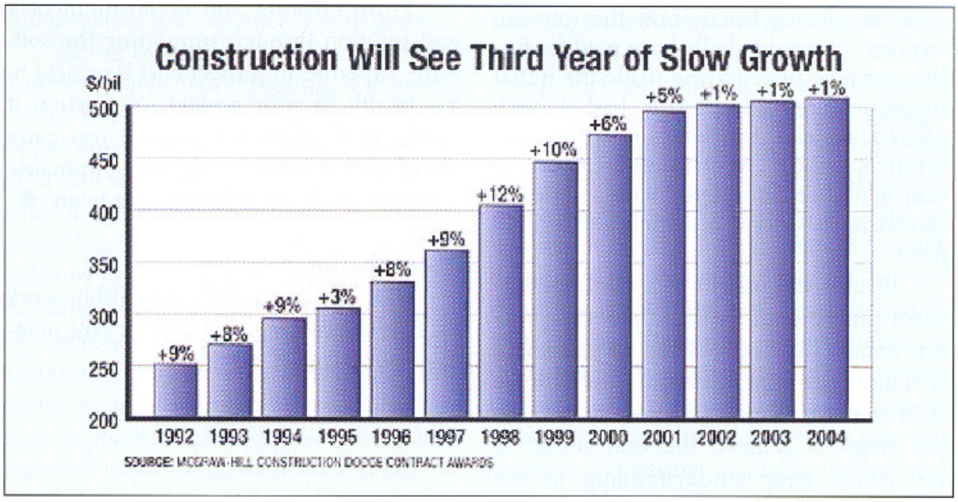


Figure 1—Economists Forecast Slow Economic Growth in 2004

objective may be to cut money, no one wants to do it at the cost of sacrificing value.

### Value Engineering: A Solution For Owners

One possible solution for owners is applying a systematic process known as value engineering. Value engineering uses analytical, creative and evaluation techniques on a multi-disciplined basis to achieve the desired functions in a design or process while maximizing value and maintaining or improving required functions [4]. It is used to eliminate unnecessary life-cycle costs without sacrificing safety, quality, environmental compliances or other functional requirements. In addition, it increases innovation opportunities, improves cost effectiveness, enhances performance, and fosters partnering among the owner, engineer, and builder.

### History Of Value Engineering

The history of value engineering is more than 50-years in length. It originated as a result of the efforts of an engineer working at General Electric during World War II (1943). Larry Miles is considered the "father" of value engineering. Mr. Miles was responsible for procuring material for manufacturing products that had a comparatively low military priority. Because of shortages occurring during the war, it was necessary to substitute one material, component, or process for another. As a result, he began specifying the material needed in terms of their function and criteria. For example: the required product to be provided must translate a rotational force into a lateral force. It must be able to withstand these stresses, fit within the area allowed, and connect to these other parts [5]. Often times these substitutions led to products that were not only cheaper, but also better. As a result, Mr. Miles became a proponent of efforts to learn how to make beneficial changes by intent rather than by necessity. The centerpiece of these efforts was to perform function analysis. He found that carefully analyzing the basic function of a material, component, or process used in the development of a finished product constituted a logical and successful means of identifying the lowest-cost, as well as the best, response to that function. Thus, value engineering was born [6].

### Value Engineering Job Plan

Over the years, the process has improved and evolved into a carefully crafted and thoroughly tested job plan. The job plan provides a vehicle to carry the study from inception to conclusion and logically separates the study into distinct tasks. It assures that consideration is given to facts that may have been neglected or overlooked in the creation of the project. Every step of the process is geared toward obtaining a result that increases the ROI (return on investment) or value for the client. Therefore, written documentation is maintained as a record of the process as it progresses. This documentation is formalized into a verbal and written presentation.

Success is ensured by adherence to the job plan. The job plan highlights and focuses attention on the pertinent issues, essential needs, criteria, problems, objectives, and concerns of the project. The phases included in a typical value engineering job plan are described in the following.

1. **Goal Definition Phase**—During this phase, the goal is clearly defined and boundaries are established. The purpose is to ensure that efforts are not wasted on non-essential tasks.
2. **Information Phase**—This phase requires the team to capture as much information as possible about the project background and estimated costs. Typically, the designer presents an overview of the project and the design development process. Examples of data to collect during this phase include design criteria, operational requirements, environmental, zoning or other regulations that affect the project, constructability, schedule, functional requirements, project budgets, and applicable building or construction codes.
3. **Function Analysis Phase**—This phase is the cornerstone of value engineering. Value engineering uses functions and a function-logic process to describe the project at its most simplistic level. Function analysis forces the team to think in new ways and to think outside the box. Every aspect of the project is described through the use of two word functions (active verb, measurable-noun descriptors) and placing those functions in a decision-logic diagram. This powerful combination helps identify the basic needs involved in the project [5].
4. **Creativity Phase**—During this phase as many ideas, processes or methods as possible are generated by which the previously defined functions can be performed. This is typically accomplished through brainstorming sessions. Critical to the success of this phase is opening the mind to any and all possibilities. No critical judgments or comments are allowed during this phase that might inhibit creative thought. At this phase the focus is on the quantity of ideas not the quality of ideas. At this stage ideas such as material substitution, relaxing tolerances, standardizing customized items, combining elements and altering the construction sequence should be considered.
5. **Evaluation Phase**—This is the point in the job plan when the ideas generated in the previous phase are evaluated. The purpose is to assess those ideas that have the greatest probability for implementation. Each idea is examined individually as to feasibility, cost, and value received. These ideas are tested against the criteria and limitations established in the goal defining phase. In addition, economic analysis, life-cycle cost analysis, tradeoff analysis and sensitivity analysis are performed to better evaluate the value of each idea. Ideas can also be rated on safety, reliability, environmental impact, aesthetics, maintainability and other non-economic considerations.
6. **Development Phase**—The purpose of this phase is to take the remaining ideas from the evaluation phase and develop them into workable value engineering recommendations. The recommendation proposal provides enough information to allow informed decisions to be made. A typical proposal will describe the recommendation, cost of implementing the recommendation, advantages and disadvantages of implementing the recommendation, and supporting data such as sketches, calculations, life cycle cost

comparisons or product information sheets.

7. **Presentation Phase**—An informal briefing of the value engineering process and results is given to the decision makers. This step in the process also provides an opportunity to clarify any misunderstandings between project requirements and the value engineering recommendations.
8. **Implementation Phase**—At the owner's option any or all value engineering recommendations are implemented. Follow-up may be required during this phase to ensure the recommendation is properly developed by the architect or engineer.

**Why Choose Value Engineering?**

As previously mentioned, value engineering is just one of the tools available to owners seeking to keep project budgets under control and cut cost. Unfortunately, most owners believe that designers perform value engineering as a normal part of their design or that it should only be done when a project is over budget. So why should an owner choose to perform a formal value engineering study? What are the advantages to using this process? The number one advantage to using value engineering is that it is the most cost effective tool available to achieve the required functions at minimum cost, without sacrificing needed quality, safety, environmental compliance, or other functional requirements. In addition, a properly executed value engineering process will yield results that eliminate unnecessary costs, enhances performance, focuses on improved value, ensures compatibility between decisions and program requirements, allows decisions to be made realizing the full cost impact, validates decisions, resolves issues, provides for a better design and reduces construction claims.

**Keys To Successful Value Engineering**

Key to ensuring the successful outcome of a value engineering study is choosing the proper format for the study. There are four basic approaches to performing a value engineering study.

- The in-house approach consists of a team and leader supplied by the owner.
- The outside leader approach consists of a team supplied by the owner, but the leader is from an outside source such as an independent consultant.
- The combined approach, as the name suggests, combines the first two approaches. This approach is the most widely used approach and consists of some team members supplied by the owner and some from outside entities. The team leader is typically from an outside entity when this approach is applied.
- Last, the outside team approach, consists of all team members and the leader from outside sources.

In addition to choosing the proper study format, other elements key to the successful outcome of the value engineering study include matching the value engineering workshop scope to the project size and complexity and matching the technical expertise on the team to project needs.

Providing ample time in the project schedule for full implementation of the value engineering process and providing for value engineering scope in the designer's contract are also important factors to consider.

Moreover, value engineering depends on teamwork. Teamwork will be achieved when common goals and motivations are established. It is important to note that when teams are kept to five to 12 members, teamwork is achieved through healthy communications.

Owners may believe that value engineering can only be performed on high dollar projects. Although value engineering is more readily performed on costly projects, other considerations may include the following.

- complex projects;
- projects with less experienced designers;
- projects with new technology elements;
- projects with tight design and/or construction budgets;
- projects with aggressive schedules;
- high visibility projects; and
- projects where design has been driven by factors other than technical requirements

**When Should Value Engineering Be Done?**

Value engineering can be applied at any time during the life of a project, from planning and design up until completion of construction. On designs of a repetitive nature, experience from a completed construction project can prove invaluable during value engineering studies. Value engineering has its greatest impact when it is conducted at the appropriate stages of the project. The proper time to perform value engineering is controlled by the following two factors:

- obtaining maximum value from the value engineering effort; and
- the ease or difficulty, with which value engineering may be applied. Greater savings normally result if value engineering is applied early in the design phase (See point A in figure 2).

This is most desirable for several reasons, including the following.

- maximum savings will usually result from changes effected prior to

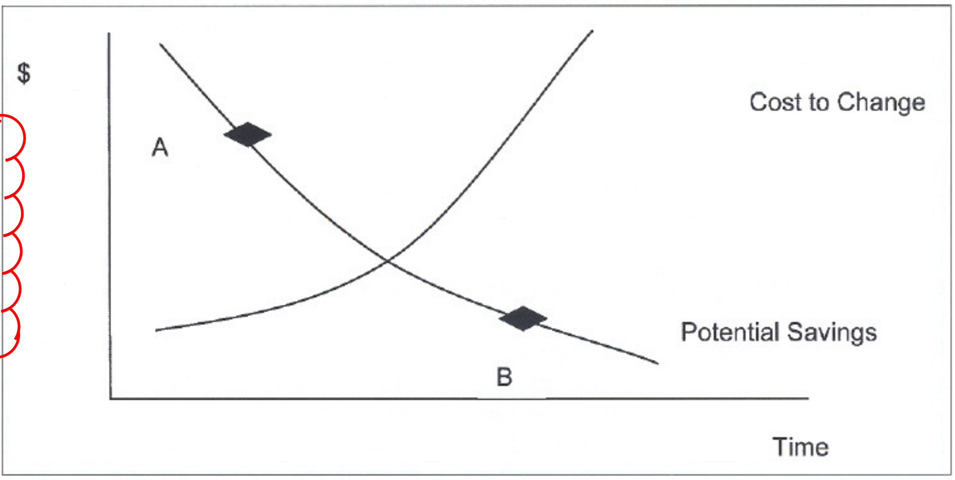


Figure 2—Timing of Value Engineering Opportunities

entering into the contract for construction;

- implementation costs (including redesign) will usually be lower;
- acceptance for implementation will be greater; and
- there will be less effect upon the overall project schedule.

### Timing of Value Engineering Opportunities

Although, as indicated above, there are good and sufficient reasons for applying value engineering early in the life cycle of a project, and preferably in the design phase, the potential for value engineering savings during the life of a project should not be overlooked. However, there is a point in the life cycle of one-time designs after which the cost to value engineer and implement a change may exceed the potential savings (See point B in figure 2).

In order to select the most opportune time to perform value engineering, it is necessary to relate the savings potential to the time and personnel available, the cost of the effort and the probability of implementing the change. Value engineering studies can be performed on the earliest documents available that satisfies the functional requirements of the project and includes a comprehensive engineering estimate. Conversely, value engineering can be performed as late as after construction as applied to operations, maintenance and procedures.

### What is the Cost of Doing Value Engineering?

The cost of a value engineering effort varies from project to project. Some projects require multiple studies and costs of the study will vary between studies on the same project. A single study can range in cost from $30,000 to over $100,000. The primary variables affecting costs include the following.

- the level of desired qualifications and experience of the team members;
- the number of disciplines required to address all aspects of the project; and
- the duration of the value engineering study.

Below are a few examples of value engineering studies performed and the potential or actual savings gained from each study. A noteworthy observation is the various goals achieved by each value engineering study. Although most studies focus on design improvements, the purpose of one study was to evaluate the most cost effective and efficient delivery method.

**Primary Care Clinic, Fort Hood, Texas**—This value engineering study was performed at the 30 percent design of a new 5,880 square meter primary care clinic. The project consolidated three family care and soldier care clinics for the purpose of improving the standard of care. In addition to being designed for the conventional family care, the facility would also accommodate mass examinations during military mobilization activities. The new facility was a single-story masonry structure. The value engineering team made recommendations to simplify the structural system of the barrel vault roof design, use more suitable interior finishes, simplify the crawl space and structural floor slab, simplify the storm water drainage system and reduce the site earthwork. These recommendations and others resulted in potential savings of $2.2 million on this $11 million facility.

**Lambert St. Louis International Airport-East Terminal Expansion**—This study determined that the best possible method for packaging the bids was to create three separate packages. Package A included the aircraft apron and air cargo road, in which the project bids were received at a cost of $1.5 million below estimate. Package B included the terminal and concourse. The estimate was $45.8 million. The bid date was met a month earlier than originally established. Package C consisted of the parking garage and elevated roadways. The low bid of $20.2 million was received, and this final bid represented an overall cost reduction of $17.5 million below the mean bid results.

**St. Clair County MetroLink Extension** —This project was an extension of the existing MetroLink system from the current eastern terminus in East St. Louis to Mid-America Airport in Mascoutah, a distance of 26 miles. The contract studied a double track light rail system including ballast, track ties, grade crossing, bridge decks, and special trackwork. The project's estimated cost was $29,200,000. The VE Team recommendations resulted in a cost reduction of $8,891,000 or approximately 30 percent.

This simple eight-step process has the capability of yielding tremendous results. Although many of the results are tangible and have a monetary value associated with them, there is also the possibility of intangible results, for which no monetary amount can be assigned. The improved design mentioned in the Primary Care Clinic study and more efficient bidding process highlighted in the Lambert East Terminal Airport study are just two examples of intangible, non-monetary results.

It is clear from the above examples that there is value in performing a formal value engineering study. For owners desiring to reduce project budgets value engineering provides a cost effective, value conscious alternative to simple cost cutting exercises. Over the past 50 years, value engineering has proven to be a viable resource for owners. ◆

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