Slow VE Acceptance Undermines Quality

In 1984, the Business Roundtable published recommendations from the Construction Industry Cost Effectiveness Study (CICE). The study revealed the lack of engineers providing design alternatives to their clients, seriously impacting the industry's competitive stance in world markets. What is the present state of the construction design Industry? What can be done to improve the process?

While most engineers and designers with-in the construction industry pay "lip service" to the importance of cost-conscious design produced through value engineering (VE), there are too few practitioners. This powerful tool for investigating material and construction alternatives to avoid and eliminate unnecessary costs, is seldom used at the design stage where it produces the most benefits. And, when VE is applied during the preliminary design, the technique is seldom extended to areas which yield the greatest benefits for the owner.

In their pursuit for quality in construction, U.S. design professionals have grown complacent about value engineering's impact on meeting project requirements in the most cost effective manner. Few designers recognize VE's potential to spur innovation and to bring constant improvement — key quality principles. Due to its enormous potential for cost savings and design excellence, engineers and designers who fail to implement value engineering procedures are compromising their professional obligation to the owner. This article discusses value engineering as commonly practiced in the design field and provides suggestions to expand its effective use.

Value Engineering in Japan

Other countries, particularly the Japanese, have embraced value engineering and are using it to leverage an advantage in world markets. The extent of this commitment was described in subcommittee hearings held in April 1987.

Testifying before the Subcommittee on Oversight of Government Management chaired by Senator Carl Levin, (D-MI). Alphonse Dell'Isola, an internationally recognized value engineer, noted that Japan is the leader in the use of value engineering and had gained a competitive edge in the steel industry through its use. At the hearings Dell'Isola, a vice president of Smith Hinchman & Grylls Associates Inc., who has conducted more than 1,000 VE studies, recommended a mandated program of value engineering for all government agencies.

"Value engineering is a way of life with the Japanese. The tool forces creativity, improves quality, and enhances their competitiveness. In the United States, liability is more of a concern than optimization of design," says Dell'Isola.

A Familiar Cost Effective Technique

Shortages of materials during World War II promoted the first use of VE techniques. Lawrence D. Miles, an engineer at General Electric's Purchasing Department, was assigned the task of finding parts to keep the firm's appliance production moving despite severe materials shortages. By understanding the required functions of the parts and materials, Miles found substitutes that were often better and more cost-effective than the originally required part. His work opened up the doors to incorporating VE techniques into the field of product design.

Value engineering was endorsed by the U.S. Department of Defense and was introduced to the U.S. Navy during the mid-1950s. Prompted by Secretary of Defense McNamara's Cost Reduction Program, value engineering became a U.S. Defense Department program in 1962. The U.S. Department of Defence value engineering program saves approximately $2 billion annually, even though the department has yet to tap its fullest potential.

Over the years, at least 14 federal agencies have used value engineering with a net savings in the billions of dollars, yet the U.S. federal government still lacks a coordinated effort to use the method. In another attempt to legislate the methodology for all federal departments, Congresswoman Cardiss Collins, (D-IL) introduced a bill in the U.S. House of Representatives last January to require a value engineering review of certain types of federal contracts.

Louis C. Kingscott of Kalamazoo, MI is credited with bringing value engineering back into the private sector construction and design in 1964. Kingscott, along with Dell'Isola and Hal Tufty, current president of the Society of Value Engineering (SAVE) spread the VE gospel throughout the United States and abroad including: Japan, Australia, Canada, Italy, South Africa, Mexico, Brazil, and Saudi Arabia. Presently, engineers, architects and others involved with purchasing and contract management can receive training in value engineering and certification at SAVE's headquarters in Northbrook, IL.

VE Defined

Value engineering traditionally couples design with manufacturing. In the construction industry, value engineering uses design concepts coupled with construction knowledge as a means to identify and eliminate unnecessary construction and life cycle costs. When conducted properly, the technique provides less costly and often innovative ways of satisfying project requirements without forsaking performance, reliability, maintainability, and safety. Typical savings generated by value engineering are pegged at 5-10 percent of total project costs. Pushed to its more rigorous forms, more ambitious savings can be obtained.

To achieve quality and cost competitiveness in a constructed project, VE analysis must be tailored to specific functional requirements of the customer. If the building owner places a premium on sales competitiveness and quick profit, then the value engineering process should aim at design options featuring low capital costs and reduce emphasis on selecting materials where life cycle costs are the attraction.

As currently practiced in the construction industry today, there are three main approaches to value engineering: minimal, standard, and rigorous. In the minimal approach, the construction firm conducts a value engineering study of materials and plans after the preliminary design is completed. The contractor's staff evaluates the design according to its impact on construction schedule and cost. Materials substitution and slight design changes are typically the recommendations made in this approach.

The standard value engineering study is conducted by many architect/engineers during the 35-65 percent completion stage of preliminary designs. Designs are critiqued internally according to how well they satisfy owner requirements— function, budget, schedule, codes, and regulations. During this process, expenditures relating to procurement, maintenance, and operation are considered. Alternate solutions are developed and incorporated into the final design.

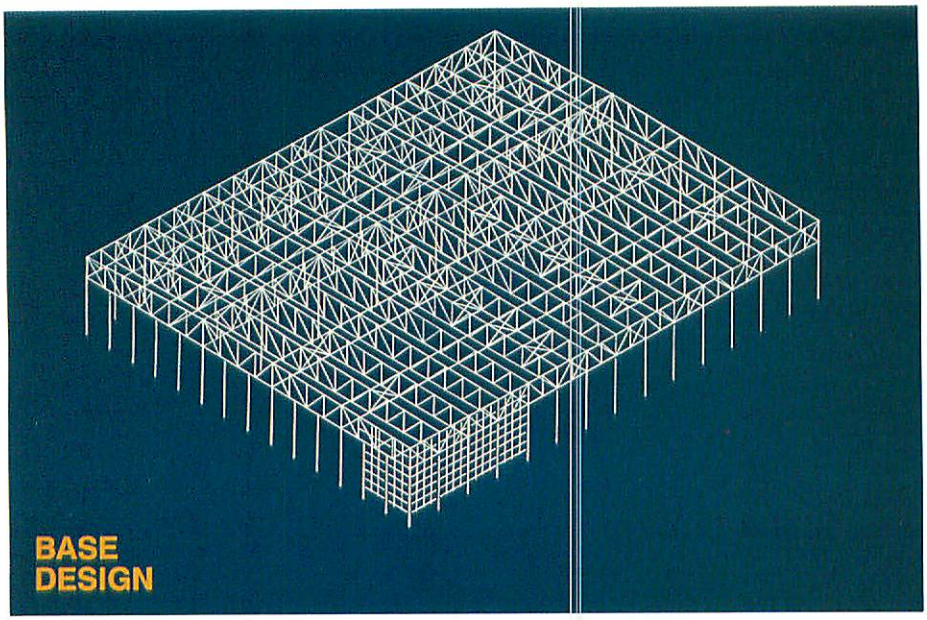
Rigorous Analysis

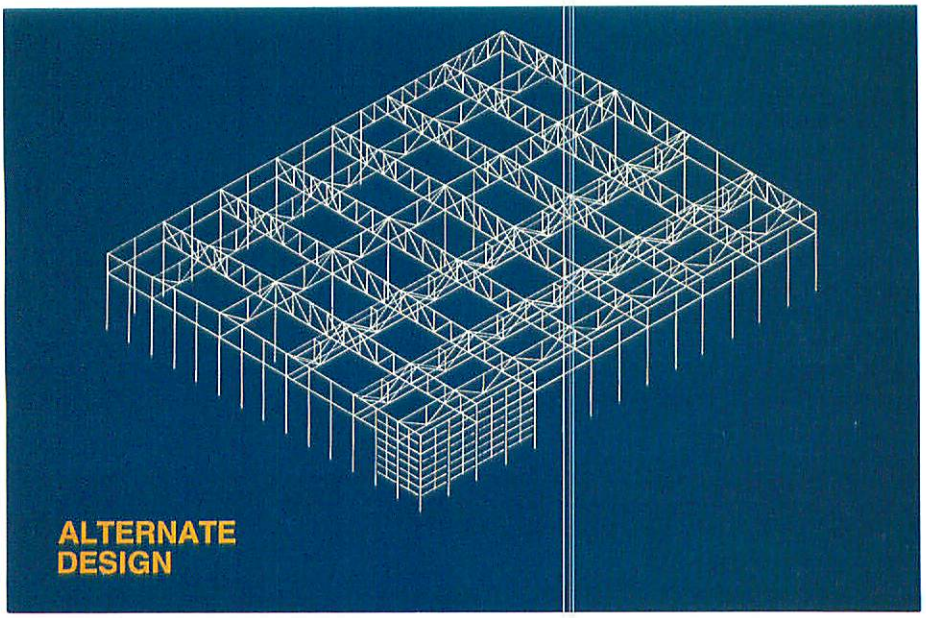
The approach to value engineering that yields the highest savings is one which analyzes the total value of the total system. A rigorous analysis considers material costs associated with the construction: use of the facility including maintenance, repair, replacement, construction methods and scheduling, and materials fabrication— including pieces to handle, fabrication costs, and availability of materials. This process opens the doors for questions about the original design concept. Does it truly meet the owner's needs? Does it satisfy the budget constraints? Does it meet the operation requirements? Is the facility constructable? Are the materials, fabrication and erection techniques simple or difficult? Was this design the best alternative for this project or was it similar to our previous projects? Answers to these questions can significantly effect the project cost, the owner's cost and the project's successful completion. Innovation comes by questioning the basis for previous discussions and asking, "How can we improve? Reduce cost? Increase quality?"

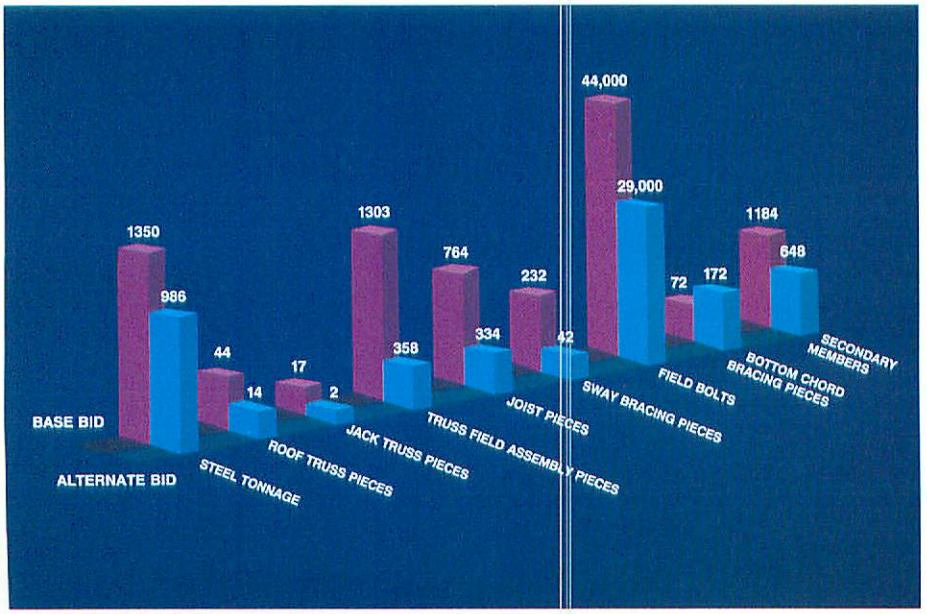
Broad Support

The ideological roots for performing value engineering during the design stage are anchored in the heart of the quality philosophy. W. Edwards Deming, revered in Japan as the father of their quality movement and considered a leading spokesperson for quality in the United States, stresses throughout his book, *Out of the Crises*, that quality is built in at the design stage.

"Improve constantly and forever the system of production and services," Deming says.







Ruby & Associates' value engineering study resulted in a 28% reduction in steel tonnage for a 100,000 sq. ft. aerospace manufacturing facility addition. The redesign required less material (50% reduction in roof joists and trusses and elimination of all 17 ft. X 50 ft. jack trusses), less labor to fabricate and fewer pieces to erect reducing shop and field manhours, material costs, and construction time.

He advocates using teams comprised of experts to work toward improving quality and lowering costs.

The design industry has yet to wholeheartedly climb aboard the VE bandwagon. Most professional design societies support in concept, the active pursuit of design alternatives to achieve quality, yet avoid coming out and recommending value engineering for construction projects. In a manual entitled, *Quality Assurance for Consulting Engineers* published by the American Consulting Engineers Council in 1986 a recommendation calls for an in-house review of a project during the preliminary design phase by experienced individuals not involved in the project.

Similarly, *Quality in the Constructed Project*, a guide published by the American Society of Civil Engineers in 1988 lists in the job description of the design professional the responsibility of formulating and studying alternative methods for meeting project requirements.

There are exceptions. Smith, Hinchman & Grylls, an architectural/engineering company with offices in Detroit and Washington D.C., has begun to integrate value engineering into its own design approach. After conducting VE studies for clients for 15 years, and building a staff sophisticated in the methodology, the firm decided to use VE as a quality control program in place of its own design process.

Implementing the methodology through in-house staff, the firm evaluates its design projects for meeting owner requirements several times throughout the design process. The effort has produced more value for clients in the form of increased cost efficiencies that have offset and in-house cost involved.

Obstacles

While VE techniques have proven value, VE in any of its approaches is not used as widely or consistently as it might be. SAVE estimates that current VE efforts are reaping only three percent of the cost savings available through the use of this powerful tool. The following list addresses some of the more commonly encountered obstacles to greater use of value engineering in the construction industry.

• **Pride:** The construction/design selection process is very competitive, and built on reputations and experience. When selected for a project, the architect/engineer or construction manager will proceed with the design based on the project program. The owner having selected the A/E or CM based on reputation and experience is very accepting of their subsequent performance.

Pride keeps the owner and project team from considering that their design alternatives, if reviewed by specialty consultants, could achieve lowered costs, more reliability, better quality, reduced schedule and increased competitiveness.

Recently a Big Three purchasing executive responded to a query about a possible value engineering services with a resounding "No. We have selected

The VE Process

Value engineering can have its greatest impact on the project when begun at the point when 30 percent to 35 percent of the working drawings are completed. At this point there are several ways of conducting the VE study. One method called an in-house review uses a team of selected staff who are uninvolved with the project in any prior capacity to conduct a systematic review of the project drawings and generate alternative concepts.

The most common approach to a value engineering study is to call in a multi-disciplined team whose members are dictated by the project type. An industrial plant project VE team could include an architect, various process engineers, a structural engineer, a contractor, a cost estimator, and a materials supplier. It is important to note that members of the VE team should have had no prior involvement with the project decisions.

The value engineering study usually takes a week to complete and includes the six basic steps listed:

1) Define the Project: The team identifies the scope of the project along with the owner's specific requirements and criteria for measuring success. Any constraints — codes, personnel, time, budget — must be understood.

2) Identify the Costs: The team isolates the high cost items (Typically 20 percent of the design represents 80 percent of the cost.). These areas may include items that cost more than they should, are undervalued, required more field assembly hours or have exotic materials requirements.

3) Seek Alternatives: At this stage, the "creative juices" are flowing as the team brainstorms alternative ideas to accomplish project aims. High-cost items are targeted for innovative alternatives that may include new materials or advanced construction technology.

4) Evaluate Alternatives: Back to reality, it is time to rate the ideas and select those which will bring the biggest improvement to the design and construction process.

5) Determine Feasibility: The team sifts through the most promising ideas to determine feasibility and estimated cost, and ranks them according to potential for satisfying customer requirements and cost reduction.

6) Report Findings: The final step in the study involves making recommendations for design changes. The report should show how to implement the recommendations — resources required, timing, risks, expected benefits and analysis of the proposal compared with the original project criteria and expectations.

Fees for VE studies usually amount to 1/10 of one percent of the total construction costs for projects more than $50 million. Smaller projects generate a fee ranging from .02 percent to .03 percent of the total construction dollars.

qualified A/Es and we expect them to provide us with the best design alternatives."

• **Owners are Unfamiliar with VE:** The report, *Integrating Construction Resources and Technology into Engineering*, published by the Business Roundtable in 1982, identifies a key impediment to achieving quality in construction: owners lack of knowledge about achieving cost reduction and shortened schedules through integrating advanced construction methods and materials into the planning, design, and engineering phases of a project. Many owners believe the technology of building is basically unchanged, when in fact the technology is changing rapidly.

• **Owners Need to Prioritize Saving Money:** Despite the difficult economic times, consultants observe that owners seldom encourage innovative thinking to save costs. Owners offer little incentive for designers to scrutinize materials and construction processes to accomplish their goals.

• **Lack of Budget:** Costs to do value engineering are often perceived to be too high. Owners frequently balk at adding the extra up-front cost of a VE study to the project budget despite the promise of documented savings. Minimal design budgets allow little time for analyzing alternatives for improving cost effectiveness.

• **Unknown Cost Projection:** Many designers lack knowledge of the cost of their design decisions and seldom, if ever, differentiate costs related to all pieces of the project. Through a lack of hands-on construction experience, designers have little understanding of materials and man hours costs, material availability, installation constraints, coordination of trades and system integration.

Japanese architects have extensive experience in construction and are able to do a better job on integrating design decisions with construction costs.

• **VE has a Bad Reputation:** Value engineering has been used improperly to reduce costs through substitution of lesser quality materials.

• **Built-in Resistance:** Many designers and program managers view a value engineering study as a challenge to their design abilities and a vehicle for making them look bad.

• **Lack of Time:** Schedule constraints stymie the investigation of design options and cost comparisons.

• **Habits:** The comfort factor involved with using standard design features reduces risk for the designer. Habit can dictate designs that send cost efficiency out the window. Comfort will not spur innovation, creativity, nor advance the quality of the final product. This is a habit that must be broken.

Overcoming the Obstacles

A key ingredient to increase the use of value engineering in construction is to spur owner awareness in seeking creative and cost-effective design solutions. As they have used the Total Quality Management concept to couple design and manufacturing throughout the auto industry, so should it occur in construction. Coupling design and construction enables up-front discussion about such factors as materials and processing options, the range of specialists required, and an understanding of the cost of the design. Above all, the process allows the participants to consider alternatives.

Improving communications within the construction industry would foster a more analytical and systematic approach to seeking design alternatives. Designers should be encouraged to visit job sites to understand how their decisions affect the construction project in relation to costs and procedures, materials availability, and impacts on schedule and quality of work. Additionally, constructors, suppliers, and construction consultants should be invited to give input into the design process. These team members can provide valuable information about alternative ways of achieving project aims and where costs can be reduced.

Despite the integration of Europe in 1992, the opening of Eastern Europe and the reconstruction of various Middle East countries, the United States is predicted to remain the single largest construction market in the world during the 1990s. That being the case, the United States construction industry can expect continued competition for market share from international firms particularly the Japanese whose United States contract volume has risen steadily since the early 1980s.

As with the automotive industry, the issue of quality has a great deal to do with how well the United States construction industry fends off the international "invasion." It is unwise to fail to use a tool that produces cost savings through creativity and innovation, without sacrificing performance or quality.

The ultimate solution to the successful use of VE lies in the willingness of the existing construction team — owner, A/E, CM —to enlist a new member, a specialty consultant. This specialty consultant must have design knowledge, coupled with construction understanding. Through this step, VE can be practiced in its most rigorous form, providing the quality and competitive edge we so desperately need.

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