

Using Value Engineering to Reduce Life Cycle Cost

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The Department of Defense has several initiatives to become better stewards of taxpayer dollars, and perhaps none have a greater reach than the drive to reduce total ownership cost. Rather than focus on specific activities or phases, reducing total ownership cost is a life cycle effort. Value engineering (VE) is a best practice process for supporting cost reduction in all phases of a system's life cycle.

VE is defined as “a systematic effort directed at analyzing the functional requirements of DoD systems, equipment, facilities, procedures, and supplies for the purpose of achieving the essential functions at the lowest total cost, consistent with the needed performance, safety, reliability, quality, and maintainability,” according to DoD Handbook 4245.8-H, *Value Engineering*. Public Law 104-106 requires all government agencies to establish and maintain VE procedures and processes. The Federal Acquisition Regulation requires a VE clause to be included in all contracts exceeding a specified threshold. DoD objectives state its net savings and cost avoidances for VE will be at least 1.5 percent of the total obligation authority.

The VE process is typically conducted in eight phases: orientation, information, functional analysis, creative, evaluation, development, presentation, and implementation. Although the greatest potential for cost control when applying VE exists in the research and development stage of a new capability, opportunities for the application of VE techniques exist in every stage, especially when considering new available technologies and the experience of actual system deployment and user feedback. There are times when a problem in reliability or maintenance may become the greatest opportunity.

Crane Army Ammunition Activity recently used VE principles to great success in a cooperative joint redevelopment with the Naval Surface Warfare Center. CAAA is co-located with Code WXR, the Navy design agent for countermeasure flares, at the NSWC installation at Crane, Ind. The effort turned unusable inventory into good materiel, supporting the warfighter, saving dollars, and easing the environmental impact of the flares.

The Requirement

Mobile jettison units 32B and 38B are decoy flares the U.S. Navy uses in several types of helicopters and fixed-wing aircraft to promote the survivability of warfighters and airframes in hostile environments. Because of the critical nature of the system, there are strict reliability protocols for testing during production and final article lot acceptance. Once a production lot has received final acceptance, the flares are placed into a quality surveillance program. The Navy had a requirement for the flares to be shipped from the existing inventory.

Orientation Phase

At the start of any VE effort, stakeholders are informed of the issues, with a focus upon identification of the problem or challenge. If there are multiple issues, priorities may be established. Scope is also of concern at this point, as a scope that is too narrow may leave potential areas for gain unexplored, while a too-broad scope may force the team to devolve into a new design effort in an attempt to reinvent the wheel.

The CAAA team took a close look at the requirement. The decoy flares consist of an igniter system that fires upon deployment, causing the main body (the grain) of the countermeasure to burn and create an intense heat source. This source disrupts the target acquisition and tracking system of the hostile missile. The stockpile of flares stored at CAAA had been produced by a private contractor and were reviewed through quality surveillance testing. Ignition issues were found in test samples, and further analysis revealed a very high failure rate.

Information Phase

In a VE effort, team performance can be improved by setting ground rules to guide the working relationship and environment. The scope may be refined as more information is gathered. The main thrust of this phase is to establish the facts surrounding the VE effort as they are presently known. Procedural challenges at this point may include overcoming institutional inertia (“that’s how we’ve always done it”); separating facts from opinions; and discouraging that time-honored creativity crusher—the immediate leap to solution.

A total cost savings of about \$7.8 million was realized while meeting the warfighter’s needs.

As part of the failure analysis in our example case, Code WXR asked CAAA to examine a few of the flares and look for potential sources of the high failure rate. The request was a normal problem-solving technique; and thus, the analysis was not recognized as a potential VE project at that point. CAAA began to look for causality in an effort to reduce any possible recurrence of similar problems in future production.

Functional Analysis Phase

While it is tempting to start with an analysis of the existing design, the true worth of VE begins at the most basic level possible. “What is this supposed to do?” is a great starting point. If we are looking at a vehicle, the most basic function might be to transport people or materiel. We can then begin to look at must-have requirements and develop an awareness of options and functionality that may have been added to the specification and go beyond the system need. This base analysis always yields some obvious pruning material.

The primary benefit of VE involves developing the most cost-effective way to fulfill the core requirements without jeopardizing performance. After the base functionality is defined, other characteristics can be provided by determining the “hows.” How will it transport people? How many people? That may lead to answers such as “by ground” and “eight seated people.” Each succeeding level helps to further refine the need, yet not define the solution. The team can then evaluate those functional areas to determine the most promising areas for the VE effort.



A U.S. Navy CH-53E Super Stallion tests the MJU-32A/B flare over the White Sands Missile Range.

U.S. Navy photograph

With a mature system in sustainment phase, VE opportunities most often lie in maintenance and upgrade efforts. Regarding the CAAA VE effort, the flare itself was one component in a widely deployed defensive system. The primary focus was on the testing failure in the flare/igniter assembly and was unrelated to the launcher or other components of the system. While the flares were sealed as a part of the manufacturing process, it appeared that excess moisture in the production environment may have caused the magnesium pellets in the igniters to oxidize to the point at which ignition of the grain was compromised. The Navy possessed several thousand flares from the manufacturing lot on hand. The operating procedures for problematic flares were to scrap or demilitarize them.

New flares could be produced, but that led to concerns of a long lead time, cost, and the environmental impact. The delay was highly undesirable for the Navy and, most important, did not support the warfighter as needed. The CAAA team re-examined the basic function of the flare (to burn intensely in the desired portion of the light spectrum) and devised a method for the flares to perform their basic function: deploy and burn to distract and confuse enemy detection and guidance systems. From the analyses, the team identified that the problem was not with the entire flare, and that the failure was isolated to the igniter.

Creative Phase

As the team enters the creative phase, members must have a good understanding of the desired function and any issues, broken down to the most basic level of understanding. This phase is the time to unleash the inventive powers of a team and develop alternative approaches.

For the CAAA team, the typical solution would have been to accept that the materiel was in an unusable condition, scrap the lot, and move forward with new production; however, VE challenges people to move from the status quo and seek new alternatives. With finished goods, the cost and lead time of replacement products must be balanced against the expense and time of rework.

While the problem with the flares seemed fairly straightforward to resolve, the biggest challenge involved the sensitive energetic materials involved. Rework procedures for the replacement of the igniter didn't exist. A new approach to machining had to be developed to provide an economically viable alternative to new production while ensuring timeliness, quality, and safety. The new approach required the involvement of the customer's design agent, the engineering team, and production and safety personnel. It was crucial to have the right team assembled, the problem well defined, and clear goals established as a result of the earlier VE steps.

Evaluation Phase

Now to bring the high-performing, outside-the-box-thinking team back to reality. In this phase, several potential concepts have been developed and must now be evaluated against the goals of the overall VE effort. For example, will the proposed solution meet customer requirements? Does it impact any other areas of the system (support, maintenance, training, etc.)? Overall cost of the proposed solutions must also be evaluated one more time in the framework of the total cost of ownership. If multiple solutions have been developed, the team must select the best few that warrant further study and development.

An early step in problem solving is to create a clear and concise statement of the problem. For VE, that includes having developed a clear understanding of the customer's needs in the functional analysis stage. Only with this communal appreciation can potential solutions be evaluated effectively.

For the CAAA team, focusing on the faulty igniters did not limit creativity; instead, it added clarity. The challenge was not a total redesign of the flare; rather, could the flare be disassembled and the faulty igniter replaced? Safety considerations were paramount, and the rework process had to yield consistent, high-quality results. CAAA had an excellent safety record as well as facilities that allowed for compartmentalization throughout the manufacturing process. That limited the risk and allowed those in the production environment to focus on each discrete operation and the quality of the solution. The team agreed that the solution was workable. The VE effort now changed from feasibility to economics.

Development Phase

After narrowing the range of potential solutions to a select few, the next step is to answer the question "What will this cost?" for each proposed solution. If there are any technical or operational hurdles to be cleared, processes must be developed to address those as well. Implementation plans should consider all aspects of the solution, including personnel, equipment, training, and all associated costs. The team may split into smaller groups to expedite the process, working to validate proposed solutions and develop cost estimates.

The CAAA team required a new process to allow for quick breakdown of the flare and safe removal and replacement of the igniter. It soon became evident that new equipment was needed to ensure safety while allowing the operation to proceed at pace, which would keep cost and delivery schedules within reason. An implementation plan, including a cost estimate, was developed addressing the need to purchase new equipment if the solution were to be practical in the production environment. The team had full confidence that the solution was feasible and was the best path to fulfilling the warfighter's requirement. It was time to present the solution and request funding.

Presentation Phase

In this phase, data are gathered and prepared to present in concise, factual fashion to the decision makers. To build the case for the proposed solution(s), thorough research is completed, developing the benefits and disadvantages of each course of action. Value studies detail the financial landscape. The presentation is designed to provide the decision makers a clear picture of the alternatives with the factual support necessary to make an informed assessment of the selected course of action.

Because the Navy design agent for the flares partnered with CAAA throughout the solution development process, the presentation phase was very straightforward. Cost estimates and

procedures were reviewed and discussed with the benefits and risks involved. The bottom line became very clear—the flares could be reworked at a tremendous savings, delivering a reliable solution to the warfighter much more quickly than new production. The greatly reduced environmental impact was a side benefit that further enhanced the desirability of the refurbishment option.

Implementation Phase

After receiving approval from the decision maker to proceed, a VE team most likely conducts a small trial as a proof of concept. Written reports, including the results of testing and any lessons learned, are incorporated into final documentation. The report, if the results are positive and support the proposed solution as expected, will greatly enhance the probability of final approval. At this point, the full implementation plan can be executed, and the organization reaps the benefits of the hard work.

The CAAA team felt very confident about the proposed solution to the flares problem. Thirty flares were reworked to validate the manufacturing process, allowing the team to look for areas of further improvement potential along with ensuring that safety protocols could be met throughout the procedure. The results of the small-scale test gave the Navy decision makers the confidence to fund a full test batch of 300 flares. From an unacceptably high initial failure rate, the 300 flares in the test performed without a single failure. The rework process proved safe, effective, and the best way to meet the Navy's need. NSWC provided funding to rework the flares, along with funding to purchase equipment that greatly improved the speed of the rework process.

A Successful VE Effort

The CAAA and the NSWC-Crane teams received the fiscal 2008 Department of Defense VE Achievement Award and the Army Materiel Command Installation Award. The awards recognized the reduction of life cycle cost and increased reliability achievements. A total cost savings of about \$7.8 million was realized while meeting the warfighter's needs.

Although the VE process is directed to be used throughout a system's life cycle, it is especially useful when presented with a situation in which conventional wisdom points to an expensive, time-consuming, or potentially wasteful process. The benefits can be truly remarkable, professionally satisfying, and, ultimately, very rewarding to the customers and those they support.

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