How Value Engineering (VE) Enhances Diminishing Manufacturing Sources and Material Shortages (DMSMS) Solutions

2008 National Defense Industrial Association
11th Annual Systems Engineering Engineering Conference
October 22, 2008

Dr. Jay Mandelbaum
Institute for Defense Analyses
4850 Mark Center Drive • Alexandria, Virginia 22311-1882
Outline

• Introduction to DMSMS
• Introduction to VE
• Relationship of the VE methodology to the DMSMS risk management process
• Real VE examples for DMSMS resolution options
• Conclusions and next steps
Problems DMSMS Addresses

- *Technology improvements:* As new products are developed, the technology used in predecessor products becomes outdated, making it more difficult to maintain the older equipment.

- *Decreasing demand:* The parts needed to repair products may become more difficult and expensive to acquire because fewer are produced as demand for them decreases.

- *Non-availability of materials:* The materials required to manufacture products may no longer be available, or they may be uneconomical to procure.
DMSMS Risk Management Process

Identification and Notification

"Sound the alarm," There must be quick and concise communication between all relevant parties when a DMSMS case first occurs.

Verification

Determine the scope of the problem, discerning which systems will be affected, and to what extent.

Options Analysis

Generate solutions to the problem, collecting data and analyzing case-specific issues such as cost and life expectancy. The best solution may be a combination of several traditional methods.

Resolution/Implementation

Determine a best solution and discern methods for implementing that best solution, including methodologies, financial budgets, expected time frames, and specific responsibilities of the parties involved.

Source: DMSMS Guidebook, p. 3-1.
Outline

• Introduction to DMSMS
  • Introduction to VE
  • Relationship of the VE methodology to the DMSMS risk management process
  • Real VE examples for DMSMS resolution options
  • Conclusions and next steps
What is VE?

• According to Public Law 104-106 value engineering means an analysis of the functions of a program, project, system, product, item of equipment, building, facility, service, or supply of an executive agency, performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety, and life cycle costs.

• Characteristics
  – Systems engineering tool
  – Contractually authorized
  – Employs a simple, flexible and structured methodology
  – Promotes innovation and creativity
  – Incentivizes contractor to help government’s value proposition
An Actual VECP for the Evolved Sea Sparrow Missile (ESSM)

• **Background**
  – The ESSM is an advanced a radar-guided missile with a high explosive warhead used for surface-to-air anti-missile defense
  – A missile safe and arm fuze prevents an unintended launch and, once launched, arms the warhead when the proper stimuli (e.g., speed, gravitational force) are received

• **DMSMS situation**
  – ESSM design called for an obsolete mechanical safe and arming fuze
  – Number of suppliers was limited and costs were high
    • Highly skilled artisans were needed for the manufacturing process, and much of the world fuze market had adapted to electronic fuzes

• The contractor proposed a VECP to replace the mechanical safe and arm fuze with an electronic one adapted from the Sidewinder missile
  – Development and implementation costs were $1,873,911; took approximately 2 years to offset
  – Total recurring cost savings equaled $6,832,000, which, when spread over the 1,600 units involved, resulted in a net savings per unit of $4,270
  – Savings shared equally between the Navy and the contractor
Factors Leading to VE Solutions

- Advances in technology
- Excessive cost
- Questioning specifications
- Additional design effort
- Changes in user’s needs
- Feedback from test/use
- Opportunities for design improvements
- Miscellaneous

Problems DMSMS Addresses

- Technology improvements: As new products are developed, the technology used in predecessor products becomes outdated, making it more difficult to maintain the older equipment
- Decreasing demand: The parts needed to repair products may become more difficult and expensive to acquire because fewer are produced as demand for them decreases
- Non-availability of materials: The materials required to manufacture products may no longer be available, or they may be uneconomical to procure
Phases of the VE Methodology (Job Plan)

- Orientation Phase
- Information Phase
- Function Analysis Phase
- Creative Phase
- Evaluation Phase
- Development Phase
- Presentation Phase
- Implementation Phase

Often carried out in a Workshop format.
Outline

• Introduction to DMSMS
• Introduction to VE
• Relationship of the VE methodology to the DMSMS risk management process
• Real VE examples for DMSMS resolution options
• Conclusions and next steps
### Linking the two Methodologies

<table>
<thead>
<tr>
<th>Phases of the VE Methodology</th>
<th>Steps in the DMSMS Risk Management Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Orientation</td>
<td>• Identification and notification</td>
</tr>
<tr>
<td>• Information</td>
<td>• Verification</td>
</tr>
<tr>
<td>• Function analysis</td>
<td>• Options analysis</td>
</tr>
<tr>
<td>• Creative</td>
<td>• Resolution/implementation</td>
</tr>
<tr>
<td>• Evaluation</td>
<td></td>
</tr>
<tr>
<td>• Development</td>
<td></td>
</tr>
<tr>
<td>• Presentation</td>
<td></td>
</tr>
<tr>
<td>• Implementation</td>
<td></td>
</tr>
</tbody>
</table>

There is a strong synergy
Potential VE Contributions to DMSMS

- Finds innovative approaches to problem solving that might not otherwise be considered using the creative elements of the VE methodology
- Incentivizes DoD participants and their industry partners to increase their joint value proposition in achieving best value solutions as part of a successful business relationship
  - Provides businesses with a strong profit-based incentive for using its skilled engineering workforce to mitigate DoD’s DMSMS issues
- Rewards contractors for making investments in DMSMS resolution options
- Allows the DoD to spread non-recurring engineering costs over time, making them far easier to fund
Benefits Realized Regardless of the DMSMS Resolution Option

Source: DMSMS Guidebook p. 4-11
Outline

• Introduction to DMSMS
• Introduction to VE
• Relationship of the VE methodology to the DMSMS risk management process
  • Real VE examples for DMSMS resolution options
• Conclusions and next steps
VE Contributions to an Existing Stock Approach

- **Definition**
  - The *current* supplier utilizes *on-hand* inventories or agrees to continue to produce the item in question
  - Typically use a life-of-type or bridge purchase

- **Drawbacks to this approach**
  - Costs for material management including packaging, storage, transportation, shelf life, and upkeep of the inventory
  - Difficult to estimate demand

- **How VE can help**
  - Value engineering incentivizes the contractor to perform the material management function and solves short-term budget problems associated with a quantity purchase
Standard Missile Radome VE Example for Existing Stock Approach

• Background
  – The Standard Missile is a surface-to-air air defense weapon is a fleet area air defense and ship self defense weapon
  – The radome is a dome that covers the radar on the outside of the missile

• DMSMS situation
  – There are few radome suppliers because of the complexity involved in finishing them to both withstand high heat and acceleration and allow signals to penetrate without distortion
  – Due to reduced program funding, the Navy halved its Standard Missile procurement rate
  – If the radomes were to be purchased on the revised procurement schedule, the unit price would increase by 50 percent due to production slow down
  – The Navy wanted to make a quantity purchase to reduce the overall cost, however it did not have the resources in the current fiscal year

• The contractor used a VECP to make the quantity radome purchase and sell future radome lots back to the Navy at the lower price, thus leading to significant savings
  – Total savings was $1,153,500 shared equally by the contractor and the Navy
VE Contributions to a Reclamation Approach

• Definition
  – Examines marginal or out-of-service equipment or supplies as a potential source of DMSMS parts
  – Equipment that is in a long supply, perhaps as a result of a planned product improvement or modernization effort where baseline equipment could be cannibalized

• Drawbacks to this approach
  – Reclaimed parts may be unserviceable or damaged
  – Probably represents only a short-term solution

• How VE can help
  – Value engineering can play an important role in making reclamation feasible
Artillery VE Example for Reclamation Approach

• **Background**
  - The M795 is a 155-millimeter high-explosive artillery projectile with a high-fragmentation steel body
  - It provides increased effectiveness against major ground-force threats at greater ranges for anti-personnel and anti-materiel targets

• **DMSMS situation**
  - Because of a world-wide scrap steel shortage, it was difficult to maintain a source for M795 steel

• **A VE study was initiated to develop a process to reutilize the steel from a large demilitarization stockpile of surplus M106 8-inch projectile shells**
  - The steel could not be reclaimed directly since the projectiles contained trace amounts of explosives
  - A process was developed to decontaminate and mill the surplus M106 projectiles to reclaim the steel
  - M795 production costs were decreased
  - The demilitarization stockpile was reduced
  - Total cost avoidance savings in FY 2006 for the 197,000 projectiles processed amounted to $9.2 million
VE Contributions to an Alternative Source Approach

• **Definition**
  – Items currently in production that are form, fit, function, and interface qualified replacements such as a superseding part listed in a specification or standard
  – May apply to aftermarket or reverse-engineered sources (discussed later)

• **Drawbacks to this approach**
  – Same as existing stock

• **How VE can help**
  – VE can increase the efficiency of the new suppliers’s production process
VE Contributions to an Existing Substitute Approach

• Definition
  – A different part that is currently being produced for a different application but is (or can be made) capable of performing fully (in terms of form, fit, and function) in place of the DMSMS item

• Drawbacks to this approach
  – Non-recurring engineering expenses
  – Market conditions may not have a favorable outcome for the new source
  – Qualifying and testing the replacement item
  – The unit cost may be higher

• How VE can help
  – Value engineering function analysis identifies viable options for items to be used as an existing substitute and incentivizes the prime contractor to invest in them -- represents probably the most prevalent use of VE for DoD weapon systems
Phalanx VE Example for Existing Substitute Approach

• Background
  – The Phalanx Close-In-Weapon-System is a fast-reaction, rapid-fire 20-millimeter gun system that provides Navy ships with a terminal defense against anti-ship missiles, fixed-wing aircraft, small gunboats, and helicopters
  – A contract was awarded to retrofit Phalanx with a manual controller to direct fire against targets of opportunity
• The contractor submitted a VECP to replace the standard military controller with a ruggedized commercial derivative
  – On its own initiative, the contractor produced a modified unit
  – Based on the test results, the contractor had confidence that the commercial derivative met all of the technical requirements at a lower cost
  – The military standard controller would cost $7,600, while the commercial derivative was only $2,100
  – Since each gun required three controllers, net savings was $16,500 per system
  – Approximately $2 million in savings were shared by the Navy and the contractor
VE Contributions to an Aftermarket Approach

• Definition
  – The original equipment manufacturer authorizes the assembly of an obsolete part and provides necessary tech data
  – A smaller company might undertake production that is no longer sufficiently profitable for a larger company at a lower price; competition also leads to lower cost

• Drawbacks to this approach
  – Market conditions may not have a favorable outcome for the new source
  – Non-recurring engineering expenses will be incurred
  – The unit cost may be higher

• How VE can help
  – Value engineering enables the development of viable aftermarket sources
AMRAAM VE Example for Aftermarket Approach

• Background
  – AMRAAM is a fire-and-forget air-to-air missile capable of attacking beyond-visual-range targets
  – The Inertial Reference Unit (IRU) accurately measures the missile vertical velocity and position enabling in-flight steering and targeting adjustments

• DMSMS situation
  – Originally, there was only one source for this expensive item
  – The contractor was aware that others were interested in furnishing this item, so the contractor provided the requirements and helped encourage others in the development of the IRU

• The contract contained a mandatory VE program and DoD recognized the value of having a second source for the IRU
  – Approximately $4 million in non-recurring engineering costs were required
  – These efforts saved $2,000 per unit
  – The existence of a second source through the VECP probably prevented the price of the IRU from increasing
VE Contributions to a Reverse Engineering Approach

• Definition
  – A producer obtains and maintains the design, equipment, and process rights to manufacture a replacement item by analyzing the part’s structure, function, and operation

• Drawbacks to this approach
  – Market conditions may not have a favorable outcome for the new source
  – Non-recurring engineering expenses
  – The new unit cost may be higher
  – Intellectual property rights

• How VE can help
  – Value engineering function analysis identifies viable options for reverse engineering parts
Missile VE Example for Reverse Engineering Approach

• Background
  – A defense missile contractor had a sole-source subcontractor for a costly warhead
  – The subcontractor was having problems meeting “insensitive munitions capability” requirements for the warhead to not explode in a fire or if dropped

• With DoD cooperation, a VECP was submitted to develop an alternative, and less expensive, source for the warhead by reverse engineering
  – Insensitive munitions capability improved by using a different process for making the explosive portion of the warhead
  – Approximately $12 million is being invested to develop the new source
  – Estimated savings is $15,000 per warhead
  – Second source also expected to control future cost increases
VE Contributions to a Redesign Approach

• Definition
  – Either eliminate the need for the part in question or replace it with another – may occur at many levels
    • The DMSMS part itself
    • The next higher level configuration item
    • An entire subsystem
    • The end item itself

• Drawbacks to this approach
  – Non-recurring engineering expenses for building and testing the new production capability
  – Qualification and certification to meet requirements

• How VE can help
  – Value engineering function analysis identifies viable minor redesign options and it systematically identifies economically viable opportunities for a major redesign when there is a high degree of interdependence among parts
AMRAAM VE Example for a Major Redesign Approach

• Early in its production, the AMRAAM missile used an Analog Range Correlator
  – The unit was scheduled to be replaced by a Digital Range Correlator as a pre-planned product improvement
  – With implementation several years in the future, the contractor was faced with producing the missile using a very difficult to build and extremely sensitive Analog Range Correlator
• The contractor submitted a VECP to use an Interim Digital Range Correlator
  – Implementation occurred four years in advance of the pre-planned version

• Savings
  – $13,000 per unit
  – Government shared exceeded $100 million
  – Contractor received over $20 million in VE incentives after being reimbursed for approximately $9 million in NRE
Outline

• Introduction to DMSMS
• Introduction to VE
• Relationship of the VE methodology to the DMSMS risk management process
• Real VE examples for DMSMS resolution options
• Conclusions and next steps
VE Enriches DMSMS Resolution Options

• VE is an extremely powerful tool and methodology for
  – Identifying a large number of resolution options
  – Evaluating their potential for solving the problem
  – Developing recommendations
  – Providing incentives for the investments needed for successful implementation

Using the VE methodology provides greater opportunity for developing and implementing innovative solutions to DMSMS problems
A VE / DMSMS Partnership Would be Beneficial

- **Nature of the partnership**
  - DMSMS community identifies problems
  - VE provides and incentivizes alternative solutions

- **Potential actions to develop a partnership**
  - Update the DMSMS Guidebook with a comprehensive treatment of VE and its application to DMSMS
  - Incorporate DMSMS examples into the DAU VE distance learning course
  - Incorporate DMSMS into the introductory VE certification training
  - Establish a DMSMS track at the annual VE professional society conference
  - Maintain and strengthen the VE track at the annual DMSMS conference
  - Augment the DAU DMSMS distance learning courses to include a section on VE
  - Include VE lessons in appropriate DAU DMSMS classroom material
Additional Actions

• Outreach to contractors and program managers
• Outreach to the PBL community
  – Use of Value Engineering Program Requirement clause
• Potential DFARS changes
Sources of More Information

• Contractual aspects of value engineering
  – DAU CON 236 (online course)
• VE methodology
  – SAVE International http://www.value-eng.org/
  – Certified facilitators and consultants
• Publications
  – Value Engineering Handbook
  – Contracting Guide to Value Engineering
  – Value Engineering Change Proposals in Supplies or Services Contracts
  – Value Methodology Pocket Guide www.goalqpc.com
• R-TOC/VE websites: http://rtoc.ida.org or http://ve.ida.org