Design for Assembly —
An Ally of Value Engineers

by Gary A. Simansky and George LeMoine

Gary A. Simansky is the Manager of Engineering Science at Pitney Bowes Business Systems. He has a B.S. degree in Manufacturing Engineering from the University of Bridgeport, a M.S. degree in Metallurgy from the University of Connecticut and is an ASQC Certified Quality Engineer. Mr. Simansky’s experience includes assignments in engineering, manufacturing and quality.

George LeMoine is a Senior Designer in the Engineering Science Department at Pitney Bowes Business Systems and has experience in both design and manufacture of business products.

Introduction

Design for Assembly (DFA) has received a tremendous amount of publicity in the trade journals and it is being noticed by Value practitioners. DFA offers great potential to enhance the Value Engineering (VE) workshop. This article recounts our experience at Pitney Bowes with DFA and the positive effects it has had on the results of the VE workshops.

Design for Assembly

DFA improves profitability through improved product quality, reduced product development cycles and lower direct and indirect costs. In the early 80’s industry recognized that design decisions influence 70% of the product cost. DFA was created to give the designer a tool for assessing the assemblability of the product during the concept stage of development.

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DFA is a design analysis tool which emphasizes the simplification of assembly operations as well as the reduction in the number of components. This concept of reduction and simplification is extended to manufacturing processes and is called Design for Manufacturability (DFM). At Pitney Bowes DFA and DFM are practiced along with VE. The overall effort is called DESIGN FOR THE FUTURE.

The analytical portion of DFA is the technique for evaluating the assemblability of a product by assigning penalty points to assembly operations other than straight down motions. Joining processes, fixturesing and rotation of the assembly are examples of operations which result in penalty points. These penalty points are used to quantify ease of assembly, assembly time and efficiency of parts usage.

A critical part of DFA is Design and Manufacturing teamwork which is also very integral to VE.

Design for Assembly at Pitney Bowes

Pitney Bowes is a $2.6 billion multinational manufacturing and marketing company that provides mailing, shipping, copying, dictating, facsimile and retail systems; business supplies and services; and product financing.

Over 450 employees have been trained during the past three years using the General Electric/Hitachi method of DFA. This includes design and manufacturing engineers as well as other important members of the product development team such as service, quality, purchasing and business planning.

We have integrated other design assessors into the DESIGN FOR THE FUTURE program for component parts such as injection moldings, turnings and sheet metal. These are not cost estimators, but assessors of design practices and tolerances that have a direct impact on quality, cost and producibility. Software based tools are used to speed the analyses.
The Pitney Bowes DESIGN FOR THE FUTURE philosophy is this:
- Involve manufacturing from the outset of a product design.
- Establish DFA goals for the product.
- Design the product and the process concurrently.
- Strive for assembly simplicity.
- Improve the manufacturability of the components.

What we feel is unique to Pitney Bowes is the incorporation of DFA in the VE workshop.

The DFA/VE Workshop

DFA techniques are used during the VE workshop for two main purposes:
1) Enhancement of the information phase.
2) Additional measurement of success during the evaluation phase.

The information phase begins with the DFA analysis so that all team members quickly understand the number of parts contained in the assembly and how they go together. The measurements of assemblability, assembly time, and part count design efficiency are obtained. These values are the baseline against which we will measure the potential success of new concepts. This analysis is particularly useful when studying a product at the concept stage when only sketches are available.

The part count design efficiency evaluation asks functional questions about each part to determine the suitability of each to be a separate part. This explosion of the part functions leads the team to a faster determination of the product functions and reduces the time required to complete the FAST diagram.

The knowledge gained from the DFA analysis also facilitates the brainstorming session because the team has already begun to think of other ways to eliminate parts and simplify assembly.

After the creativity phase, VE evaluation techniques include the design for assembly analysis for the new concepts. We then compare our scores against the original ones to measure the improvement.

Results

The addition of DFA to the VE workshop is a powerful technique that has resulted in an average of 65% reduction of assembly labor and a 65% reduction part count. Also, the level of manufacturability of the product is increased. Management acceptance is enhanced when DFA is added to the Value process.

Conclusion

At Pitney Bowes, DFA has become a great ally of VE. By incorporating DFA into the VE Job Plan, the information phase, FAST diagramming, creativity, and the evaluation process are enhanced. DFA is already a part of the corporate culture at Pitney Bowes and DFA/VE is becoming an important practice within new product development.
The World Bank Gold Mine for VE Practitioners

by S.S. Venkataramanan, CVS

A mechanical engineering graduate of Madras University, Venkataramanan started his VE studies in 1967, while in Japan. He is the Managing Director of Venconvave Private Limited (VPL), New Delhi, a consultancy company specializing in VE services and with many successful jobs executed in India and Europe. VPL is a close business associate of Value Analysis Incorporated, California, USA and they have together served more than 40 companies in Hungary alone during 1981-87.

A member of SAVE since 1975, Venkataramanan received the International Merit Recognition Award from SAVE in 1988 and the Society of Indian Value Management (SIVAM) Award for outstanding contribution to value management in January 1989. He teaches VE at universities in India and the United Kingdom and has many papers and publications to his credit all over the world, the most recent being in Brazil, October 1989.

He is Chairman of the Delhi Branch of SIVAM, a frequent Faculty for INVEST (Indian Value Engineering Society) at Jamshedpur, India and an active member of the International Building Council (CIB), Rotterdam.

The World Bank spends huge sums of money every year helping the less developed countries all over the world to execute big production or construction projects. However, nobody has thought of applying VE to any of these projects. This paper, based on several meetings and discussions with World Bank officials, is to bring out the enormous scope that exists for successful VE activity in this virgin field and thereby bring benefits to all.

VE is now over 40 years old. It has spread to many organizations and many areas of application in more than 30 countries. However, VE societies the world over are far from happy. They want to speed up the knowledge, growth and practice of VE a hundred times over.

This is a very reasonable ambition. One major citadel where VE has not made even a dent is the World Bank. More than 150 countries are members of this world body which hands out every year loans of more than $20 billion to governments, government organizations and companies the world over. That is not all. This World Bank cake, huge as it is, represents only 30% to 40% of the total project value as the borrowers have to invest their own funds in addition to the Bank funds. This increases the size of the cake to over $50 billion per year. Just note that: $50 billion every year! And yet, in all my VE wanderings around the world since 1967, I have not heard of even a single World Bank aided contract being subject to VE. Other professionals, however, have not been sleeping. They have sought and won, every year, about 10% of this huge cake, in the form of various consultancy contracts but, we, the VE practitioners are nowhere among them. And yet, it is possible for us to secure a good chunk for ourselves and thereby save even more for the World Bank clients. Our usual Return on Investment (ROI) is 10:1 or more, right? So, what are we waiting for? Let us all make an effort. Here are some suggestions.

The Bank’s processes are quite simple. They advance funds to over 125 borrowing countries and/or organizations for all kinds of projects to be executed viz., buildings, roads, water works, dams, power, petrochemicals, fertilizers etc. They are ready to approve hiring of consultants by the borrower to increase the success of the projects aided by the Bank. In doing so, their major objectives are also very simple.

• Efficiency
• Economy
• Ethics

The word “ethics” normally would necessitate international competitive bidding for high cost contracts. However, VE consultancy contracts cost little in comparison with the size of the projects aided by the Bank. In such cases, the Bank will even be ready to approve hiring of consultants on “single sourcing” basis i.e., by direct negotiation between the borrower and one selected, single VE consultant or firm, provided the borrower can convince them about just two points:

1. the proven credentials of the consultant and
2. the high probability of significant success through VE in the particular project under consideration.
If we VE practitioners/SAVE members creatively make an effort, the business can exceed $5 million per year even assuming that we get only 1/100th of 1% of the $50 billion WB cake! So we are back to our old business—selling VE!—this time, to over one hundred governments, government organizations and others, such as the thousands of companies who use the Bank funds to design, construct, commission, and operate the various huge projects. There is enormous scope both for VE and for Life Cycle Costing. Here are some examples of the kind of projects funded by the World Bank every year.

A Selection of World Bank Projects in the Pipeline, Which Can Yield Excellent Results Through VE Studies


<table>
<thead>
<tr>
<th>Country</th>
<th>Type</th>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>Power</td>
<td>National Thermal Power Corporation—Ash Disposal facility.</td>
</tr>
<tr>
<td>China</td>
<td>Industry</td>
<td>Shanghai Machine Tool Works—product upgrading and management consultancy services.</td>
</tr>
<tr>
<td>Fiji</td>
<td>Urban</td>
<td>Affordable housing for low income families—design and construction.</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Industry</td>
<td>Energy saving programs/energy audit in industrial sectors especially fertilizer industries, ammonia plant, etc.</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>Industry</td>
<td>Textiles and manmade fibers—export-oriented plants.</td>
</tr>
<tr>
<td>Chile</td>
<td>Industry</td>
<td>Pulp and paper—new plants, design and commissioning.</td>
</tr>
<tr>
<td>Kenya</td>
<td>Railway</td>
<td>Motive power, rolling stock and operation.</td>
</tr>
<tr>
<td>Kenya</td>
<td>Water</td>
<td>Water supply and sewerage system; training and technical assistance.</td>
</tr>
</tbody>
</table>

You wish to have more details? Then, please write or call The United Nations Dept. of Public Information P.O. Box 5850 Grand Central Station New York, NY 10163-5850 Tel: (212) 963-1516 for a copy of their biweekly journal "Development Business". Annual subscription is about $300 but you may buy just one issue. Then look for the pages entitled "Monthly Operational Summary." It gives "the earliest leads to business opportunities."

The lead time for Bank funding to be approved can take from a few months to one or two years. That is plenty of time for us to move in and convince:

1. first, the borrower, and then
2. an individual called "the task manager" in the Bank who oversees the progress of the project till final completion. These are the two crucial people to be sold on VE. (There are 2000 task managers on the Bank's rolls, one for each project.)

If the borrower is himself willing to meet the costs of the VE consultancy, then paragraph 2, above, can be done later.

From my side, I have had several meetings with the World Bank officials in Washington D.C. in 1986, 1988 and recently, in November 1989 and also with their special team who came to India in March 1989. This article is one result of those meetings; now, my efforts are directed at some of the borrowers in India. At my suggestion, our VE colleagues in Brazil will be making similar efforts in South America.

I hope this article will not only generate interest among all SAVE members, VE consultants, practitioners and promoters, but also a desire/determination to expand horizons for VE in a high potential direction. Contributions on the subject will be appreciated.

Conclusion

Steps to be taken
1. Examine the names of borrowers and projects in various countries by studying the U.N. publication "Development Business."
2. Select your expertise area and the names of the concerned borrowers.
3. Contact these borrowers and convince them of the effectiveness of VE (use your associates in different countries).
4. Have the borrower seek World Bank help to fund the VE consultancy job. Then, together with him, meet (or write) the Task Manager at the WB and secure their funds sanction.
5. Execute the VE services to the total satisfaction of the borrower and the WB.
6. Repeat the process with more borrowers in different countries.
7. Then register with the WB as a recognized, proven consultant in VE.

Good luck!
Value Analysis (VA) is a method which analyzes the basic function of buildings and projects and is moving into local government from the federal and state levels where it has a proven track record. The average VA study can save government up to 15 times the actual cost of a study. The following examples are typical:

By using this little-known process, those in charge of the Hyperion Energy Recovery System—Los Angeles' $250 million sludge-to-energy project—identified money saving ideas that potentially could have saved $100 million. While many of the project team's ideas were rejected as impractical or otherwise undesirable, the project's managers did implement savings worth $6.1 million in the first year and $20.5 million over 10 years. That's just under 8 percent of the total HERS system cost.

Among other things, they eliminated 24-hour surveillance of three regional data control stations, opting only to staff the headquarters data station. By doing so, they eliminated 9 eight-hour shifts, 365 days a year for an annual cost savings of over $315,000.

Using a full-blown VA process, the state of Illinois found similarly creative ways to save money when it tackled the problem of what to do about thousands of smaller bridges on two-lane roads which had far outlived their expected 50 year lifespan. Taking a systematic look at what was really needed from these bridges made it possible to save 49 percent of the original cost estimates to construct a bridge.

**So What is VA Anyway?**

Value Analysis, also called Value Engineering, or Value Management, is a way of analyzing any construction project, management process, or purchased item to systematically reduce costs or improve performance. It is based on the insight that buildings and processes all perform certain functions. Usually, one of these functions is the basic function and others are secondary and desirable or secondary and undesirable.

The basic function itself might be accomplished by using different processes, items, or materials. This “function analysis” is not just brainstorming; in fact, it is taught in a 250-hour special course at the University of Wisconsin and leads to a degree as a Certified Value Specialist.

The examination of problems, methods, and projects from the standpoint of function allows the city official to decide which function he or she really wants—which is basic, or almost so—and which he can do without. He has a tool for making intelligent choices.

**Who Uses Value Engineering?**

VA is now used by over half the Fortune 500 corporations. One such company, Philips Industries of Dayton, Ohio, was 451st in last year's Fortune 500, but ranked 79th in return-on-equity, in part because VA studies at Philips have saved the company $62 million since 1981.

The Navy introduced VA to the public sector and renamed it Value Engineering. Today all Pentagon projects over $10 million require VA. The Department of Defense has saved $9 billion through VA. The General Services Administration requires a VA study for every federal building project over $2 million, at the 30 percent to 50 percent design stage. The General Accounting Office uses the VA methodology in project reviews. The Environmental Protection Agency requires a VA study of every state grant proposal exceeding $10 million, and as a result some forty states have used VA analyses for EPA-financed waste-water treatment plants. The federal Department of Transportation mandates that states use VA on major federally-supported highways, and has given VA training to no less than 1,465 state highway officials, who proposed over $250 million in savings. Twenty-three states use VA in their transportation department. CalTrans has used it since 1969, and realized $80 million in savings through 1984.
The City of New York has the nation's largest local government VA program. It is staffed from the Mayor's Office of Management and Budget. The city contracts for all its VA studies, and has undertaken seventeen such studies through 1987. These have all been on capital projects ranging from $5 million to $250 million. For these seventeen projects, initial cost savings have totalled $125 million on projects originally costing $900 million, a 14 percent overall savings. The redesign of projects has allowed the city to make additional savings on operating costs and debt service, for a total of $345 million over ten years. The entire city VE program costs a fraction of that amount.

A VA done for the city of Heppner, Oregon cost $40,000 and saved $11.6 million, a return-on-investment of 290 to 1. The study resulted in the state's first roller-compacted gravity dam. The Rosemont Fire District in West Linn, Oregon cut the construction costs of two new fire engine bays almost in half by using VE. It also resulted in cutting the cost of the Interstate 90 floating bridge in Seattle by 28 percent by developing a new design for "folding pontoons." The Port of Portland saved $1.3 million on ship berths estimated to cost $8.6 million when a VE study indentified a less expensive material to replace steel bulkheads. And the City of Salem saved $279,000 by making minor changes in the city maintenance shop was run. Total savings recommended by the VE study totalled $335,000.

What to Expect During a VA Study

A Value Analyst assembles a team of important players from as many areas within an organization as are affected by the construction of management problem. This is the Value Team. The Value Analyst then typically leads this team through a process which includes seven phases.

The first phase, Preparation, includes defining the problem, establishing goals, gathering information and identifying the use. Phase two measures user attitudes and calls for focus panels to research the function of the project. The Information Phase, step 3, helps to define and cost functions as well as determine "value mismatch." The fourth phase is Creativity where the function is kept in mind at all times. Phase 5, Evaluation, involves input from experts which leads to phase 6, Development. This includes developing proposals, and anticipating roadblocks. The final phase includes presentation and follow-up on ideas.

Even in this full-scale and extended format the total hours of seminar remain at around 40. Since the Value Team is itself local government managers developing their proposals for other managers, the final report is the city speaking to the city. As New York City's VE director Bill McElligott has noted, VA often offers the only chance of interdepartmental communication on large projects.

Conclusion: How Do You Start?

Local governments are beginning to catch up with state and federal departments in practicing VA. Because it works so well, and because the federal government has mandated it for state and water transportation grants, further growth of the method is in the cards for cities. By calling or writing the information sources listed, the manager who would like to find out more can learn enough to decide if this method is what is needed to provide a higher level of service to the citizens we serve at the lowest cost possible.
Could we pretend, just for a moment? Let’s project into the future . . .

It is an honor to speak to you — the American Association of Value Engineers — on this beautiful June morning in the year 2000. As you may recall, it was 11 years ago — June 26, 1989 — that I spoke to you last. At that time, your organization was called the American Association of Cost Engineers. But much has happened since that time. In fact, the decade of the 90s took the role of the cost engineer to dazzling new heights. For example:

- Remember the antiquated transportation systems of 10 years ago — especially those old four-lane freeways here in California? Today, thanks to an increased emphasis on project controls, CalTrans’ system of monorails and bullet trains is a model for the nation.

- US President Dan Quayle — just reelected by a landslide — won largely on his promise to create a new cabinet post — the secretary of Cost and Value Engineering. Never again will any federal project be approved unless they know how much it’s going to cost!

- And, of course, now that the American public has seen the value of nuclear power, its energy needs are no longer a topic of controversy. In fact, San Diego County officials will soon kick off “Nuclear Power Appreciation Week” as San Onofre Units 7 & 8 prepare to come on-line just up the road.

It’s good to see so many old familiar faces, but I’m also glad to see quite a few new faces as well — bright young men and women representing a new wave in your profession. This is indeed an impressive group — aggressive, sophisticated, well-educated, and attuned to the needs of industry. Certainly, this organization has had a great deal to do with advancing its members to the highest levels of professionalism. And the value of that professionalism has been recognized worldwide. Your offices in the Soviet Union, China, Iran, and Burma are evidence that value counts in any language, and through any political environment . . .

Welcome back to 1989, and thank you for bearing with me in my brief flight through time. I took that flight for a reason, which I’ll get to in just a moment. But first, I’d like to take just a second to thank you for your kind invitation to be here today — I am honored. The reason for my momentary travel through time a few seconds ago: I did that to dramatize the point of my talk — the need for cost engineers to look up from their desks, look out to the horizon and into the future. Maybe your name of “cost engineer” won’t give way to “value engineer.” But it could happen, because today, the concept of “value” is becoming far more important than dollar “cost.” And let me be clear on my choice of words: I’m not talking about “value engineering” as that relatively new field is known to you, but “value” as a state of mind.
And this notion supports so directly the theme for this conference: "Sailing Ahead to Technical Excellence." Certainly, any discipline of engineering is based upon the need for technical excellence. But today, I’d like to share a thought of why technical excellence alone may not be enough for the cost engineer of a decade hence. To lay that groundwork, let’s take a quick look back in time at Fluor Corporation. This will help illustrate the importance of your field today, and its relative importance tomorrow.

A few years ago, much of the engineering and construction we did at Fluor Daniel couldn’t accurately be described by using the term “projects.” Instead, they were multibillion-dollar international complexes, with construction lifespans lasting as long as 10 years. We proudly referred to them as “megaprojects.” A home office task force could include more than 1,000 engineers and technicians, with as many as 25,000 workers in faraway places like Sasol, Yanbu, and Cilacap. A single effort of this magnitude could employ as many as 120 cost and scheduling engineers.

At that time, high inflation meant most projects were schedule driven, and most contracts were of the reimbursable-cost variety, making them fairly safe and lucrative. The typical cost engineer tended to operate in a vacuum, not knowing in-depth what the other disciplines were doing. His/her closest co-worker was a massive mainframe computer, somewhat reminiscent of the Star Wars character “Jabba the Hut.” “Jabba” was temperamental and housed, like some pampered, exotic creature, in an air-conditioned room. To manage data and generate reports, the cost engineer filled out rows and rows of little boxes on “green sheets.” These, in turn, would be given to keypunchers who would dutifully feed them to Jabba. But everyone vied for Jabba’s attention, so getting answers to the electronic questions sometimes took 3 or 4 days.

Today, old Jabba seems like a dinosaur of an era long past, and so he is. But I would be wrong to similarly dismiss the work of those cost engineers. They were integral in establishing Fluor Daniel’s reputation as a leading builder of projects — both large and small. But life is much different for today’s cost engineer! Inflation is lower, the world is smaller, and competition for our clients comes in many shapes and sizes; so, our projects are more cost sensitive than ever. Profits are harder to come by, and I think that means that cost engineers must approach their jobs in new ways. Our projects tend to be smaller — instead of a roomful of colleagues, there are a handful. And instead of feeding a mainframe, cost engineers now talk directly to personal computers. And, with the advent of computer-aided design, they have a different product from which to measure progress. They’ve had to — in essence — teach themselves how to measure a project they can’t see or touch. And, they are expected to do more than simply assemble and manipulate data.

Another result of the smaller, cost-driven project is an increased dependence on teamwork. That handful of cost engineers must do what needs to be done — not necessarily what the job description reads. And today, everyone, including procurement, cost estimation, and construction management, shares the same CAD database. This kind of sharing encourages people to work together more closely.

And what of tomorrow? Well, I can’t guarantee what Dan Quayle will do when he becomes president, if he ever does! But I can guarantee that the role of the cost engineer will become more important as each year goes by. And indeed, while you may not be known as “value engineers,” the term “true value” will come to mean much more than a chain of US hardware stores. Let me explain:

Today, engineers — no matter what discipline — are in danger of becoming walking anachronisms.

But that begs a question: freedom to do what? Plenty! But don’t expect more of the same, because the cost engineer of tomorrow must be a different breed if we in industry are to meet the demands ahead of us. Henry Luce once said that “business is a continual dealing with the future — a continual calculation, an instinctive exercise in foresight.” And he was right. We
can't wait to see what change brings. We must anticipate change and act upon our beliefs.

And this is where you come in. What your company needs from you — as cost engineers — won't always be found in the pages of a contract, or in a memo from your supervisor. Cost engineers are increasingly expected to provide overall evaluations, comparing a project's one-time capital costs to its long-term maintainability. You are also becoming a vital part of the sales effort by helping to create proposals. To do these things well, you must be in tune with the needs of your clients, your products, and the overall strategies of your companies. You must take the initiative in creating value — for the work you perform, for your companies, and for yourselves.

Increasingly, your years of experience and judgment will be called into play. I'm sure each of you can recall a time when the cost of a project or product ended up to be wildly off the estimated mark. Why did that happen? Usually — at least in my experience — it happened because of an external problem that no one anticipated. It might have been negative public reaction or a steeplechase of bureaucratic obstacles. So your ability to anticipate and analyze those kinds of problems is becoming critical.

But it doesn't end there. The firms you work for — no matter what industry they represent — operate in a world that is just a little bit different than when I began this talk at 9:00 a.m. No senior management team can keep pace alone. What they need are Renaissance men and women — at all levels — who understand the world as it is today and as it might be tomorrow. The cost engineer of tomorrow must know more, do more, and be more than just a technical genius. He or she must be attuned to world events and what those events could mean. After all, change can be as quiet as the murmurs of two scientists bent over results of the latest cancer research. Or, change can be as loud as the crack of gunshot and the cries of students in the streets of Beijing.

So, with this ever-changing landscape, you must take control of that which you can control. You will decide where you will be next year, in 10 years, in 20 years from now. Be leaders — not just engineers. Start today in challenging your associates to reach for more creativity, to be more innovative. Use this conference as a stepping-off point, as a launching pad toward a higher level of excellence, toward a concept of creating more value through cost engineering.

Thank you.
Partnerships for Success

by Arthur Mudge, CVS, Fellow

Mr. Arthur (Art) Mudge served as Vice President and Manager, Value Planning of Joy Manufacturing Company for 24 years. In 1987 Joy’s Value Activity was the first company to be selected to receive the “Excellence in Value Engineering” award from the SAVE.

As a member of SAVE he has served as Vice President-International, Chairman and Member of the Certification Board; as member of the International Affairs, Professional Development, and Case History Committees; also as founder and president of the SAVE Golden Triangle Chapter of Pittsburgh, Pennsylvania.

His book, “VALUE ENGINEERING, A Systematic Approach,” Value Engineering, Part I is being used by numerous colleges/universities, companies and organizations throughout the world as their VE training text. It has also been translated into both Japanese and Russian.

The accomplishment of a successful VE Program requires the development and constant use of a multitude of partnerships. Partnerships established and maintained by individuals, teams, groups and organizations. In each instance they are dedicated to improvement through innovative change. Change which is so controlled as to maintain or improve the necessary performance, quality, maintainability and reliability of any project undertaken. This type of change in turn contributes to the maintenance and improvement of cost and the competitive position of a company or organization.

These partnerships for success are and must be both interlocked and interactive like a row of dominoes. They must be developed and maintained jointly so that meaningful, managed change can be accomplished. Although they are interlocked and interactive, they will be described separately for clarification.

The first partnership must be between the individual and the VE Methodology. Such a partnership has to be constructed so that it develops a full understanding and use of the fundamentals and application of the methodology. Results of this kind can only be accomplished through the individual’s participation in an organized learning process. A process which recognizes the reality of the old Chinese proverb, i.e., “Tell Me - I Forget; Show Me - I Remember; Involve Me - I Understand.” As this partnership is being constructed it aids in the development of the second one.

The second partnership, which goes hand in glove with the first is between the individuals and the development of their innovative imagination. The seeds of this ability are present within each individual. How these seeds are nurtured and developed depends on the individual, the organized training received and the organizations environment. In both this and the first partnership, imagination is the key. Its importance is highlighted by Napoleon’s statement; “Imagination rules the world” as well as by Einstein’s belief; “Imagination is more important than knowledge, for knowledge is limited to all we know and understand, while imagination embraces the entire world and all there ever will be to know and understand.” The dynamics of innovative imagination are fostered and stimulated by the workings of the “Value Circle” of the VE Job Plan, it’s forceful questioning concepts plus it’s evaluation and investigation techniques. These first two partnerships enhance the construction and overall development of the third partnership.

The third partnership encompasses the interaction directly or indirectly between the individuals involved in the innovative change activity. This partnership aids in the establishment of the activity as part and parcel of the culture of the organization while guarding against it becoming a cult within the organization. It is essential in the development of this partnership that everyone recognize that each of the technical disciplines involved do speak somewhat different languages. With this understanding in place the various disciplines can incorporate the VE concepts as the common and unifying language. The unifying language enhances one of the greatest strengths of such a partnership which lies in its openness and cultural diversity, allows
different kinds of people to foster or adapt to changing circumstances and to flourish and advance in different ways. Each of these three partnerships must in essence be fostered and maintained by the fourth partnership.

The fourth partnership is the one constructed and developed between management, at all levels, and the individuals involved in the other partnerships. This is a partnership which is vital for the activity to become a meaningful part of the organization and it’s culture. Management’s involvement is a critical element in establishing and maintaining an activity that will produce innovative changes that will assist in maintaining or improving the organization’s competitive position in the markets that it serves. Such a partnership is implemented and maintained when the participants agree upon and establish specific goals, install the necessary activity coordination, organize and schedule meaningful training programs, institute criteria by which projects are selected, worked on, with results measured and audited. Management should also develop and put into place the means of positive recognition of achievements (not monetary) of the activity and the individuals involved. Supporting the internal partnerships of the organization are those with outside groups.

The fifth partnership, which adds greatly to the effectiveness of the first four, is between the individuals and groups within the organization and the organization’s suppliers. By forming such a working partnership with the suppliers the organization’s storehouse of knowledge, abilities and techniques are greatly enhanced and increased. This part of the partnership constantly brings in to use the latest technology, equipment and individual inputs. This partnership when coupled with the sixth one tends to insure the successful development and implementation of significant innovative changes.

The sixth partnership is between the organization and it’s customers. By forming this as a workable partnership the organization is assured of an open discussion regarding proposed innovative changes. Such discussions provide the means whereby the participants review, question and determine the necessity and/or purpose of the customer’s specifications, requirements and desires. They also allow the organization to communicate to the customer the latest developments resulting from their abilities, skills and technology.

The seventh partnership, although somewhat informal, is between individuals in the organization and their counterparts in other companies, organizations and professional societies. Such partnerships assist everyone involved in remaining up-to-date with the latest VE techniques and concepts, changes and developments in technology, and with each others positive achievements. Such worldwide partnerships assist in advancing developments which enhance innovative change.

The interactive “software” common to all of these partnerships for success is the unifying language established by the VE Methodology. This language in turn fosters imagination and results in significant innovative changes which contribute to the success of both the organization and its customers. It gives the partnerships the tools and concepts by which they become optimistic about their abilities and the future, develop a constructive discontent, acquire the ability to recognize and break old habits and attitudes, become somewhat independent thinkers and openly seek alternatives for improvement through innovative change. Each of these points are discussed, described in detail and their positive audited results are shown in one or more of the case histories described in each of the three books of this VE trilogy.

Management’s involvement is a critical element in establishing and maintaining an activity that will produce innovative changes that will assist in maintaining or improving the organization’s competitive position in the markets that it serves.

The interactive “software” common to all of these partnerships for success is the unifying language established by the VE Methodology.

The following books can assist both the individual, team and organization in developing and maintaining the partnership for success.

- “VALUE ENGINEERING, A Systematic Approach,” Value Engineering - Part I, by Arthur E. Mudge, CVS-Published by J. POHL ASSOCIATES, Pittsburgh, PA.
- “SUCCESSFUL PROGRAM MANAGEMENT, Sharpening The Competitive Edge,” Value Engineering - Part II, by Arthur E. Mudge, CVS-Published by J. POHL ASSOCIATES, Pittsburgh, PA.
- “INNOVATIVE CHANGE, 101 Case Histories,” Value Engineering Part III, by Arthur E. Mudge, CVS-Published by J POHL ASSOCIATES, Pittsburgh, PA.
- “THE GOAL, A Process of Ongoing Improvement.,; by Eliyahu M. Goldratt & Jeff Cox-Published by North River Press, Inc., Croton-on-Hudson, N.Y.
Membership in SAVE or other VE Societies and related professional organizations throughout the world will add significantly to the probabilities of the success of these partnerships.

The incorporation of a formal VE Activity, as described in these books, into an organization assists in forming the partnership necessary for success, which in turn produces a culture conducive to the development and acceptance of innovative ideas and change while maintaining the necessary quality. Such a culture enhances and strengthens the competitive edge of the organization.

“To cherish traditions, old buildings, ancient cultures and graceful lifestyles is a worthy thing - but in the world of technology to cling to outmoded methods of manufacture, old product lines, old markets, or old attitudes among management and workers is a prescription for suicide.”

Sir Leuan Maddock

“Somehow every organization must make room for inner-directed, obstreperous, creative people, sworn enemies of routine and status quo, always ready to upset the apple cart by thinking up new and better ways of doing things.”

Admiral Hyman G. Rickover
Value Engineering Study for Alternate Construction Methods

by Michael P. Nowak, RA

Michael P. Nowak R.A. is a licensed architect with O'Brien and Gere Engineers in Syracuse, New York specializing in design services for Industrial and Municipal projects involving complex engineering processes and providing VE for architectural concepts and designs. He is a member of the American Institute of Architects and SAVE.

Introduction

In late 1988, Onondaga Savings Bank of Syracuse, New York, Central New York's largest publicly owned banking institution, sought alternative ways for cost savings on construction methods for renovation projects for their Syracuse office tower.

History

Onondaga Savings Bank's Vanderbilt Square Tower is an eight story protected steel frame structure built in 1961 as a 155,000 square foot retail, drive-in banking, parking, and office tower complex. The lower five floors of 25,000 square feet each contain the drive-in banking facility and retail shops on the ground floor level, four levels of parking garage spaces above, and three levels of tenant office space of 10,000 square feet each, on the top three floors.

Vanderbilt Square, as the complex is called, is named after the nineteenth century entrepreneur Cornelius Vanderbilt who brought railroad passenger service into Syracuse and Central New York by erecting a station on the same site sometime in the 1860s. The building stood until 1895, when a new station was built approximately ¼ mile to the west, and offices and shops replaced the station until construction of the Vanderbilt Square Tower, some 66 years later.

Existing Construction

Typical of mid-rise office tower construction in the early 1960s, Vanderbilt Square is built of steel frame, fire protected by a spray-on fibrous cement-asbestos coating, floors are cellular steel deck with lightweight concrete topping, the roof structure is built-up roofing over insulation and steel decking, and exterior walls are metal framed curtain wall over precast panels supported by the main structural frame. Interior construction consists of suspended drywall ceilings with a layer of ¾ inch thick interlocked mineral fiber ceiling tiles glued to the underside of the drywall ceiling. The office tower walls are primarily metal stud with drywall and panel finishes depending upon the class of offices in that particular space. Floor finishes typically are either vinyl tile or carpet.

Floor to floor height in the Vanderbilt Square Tower is 12'-4". With a typical finished floor to finished ceiling height of 9'-6", approximately 27" of clear space is left between the top of the ceiling to the underside of steel floor deck for mechanical space. A two duct conditioned air system, light troffers with slotted grilles for supply of conditioned air, down lights, and power and communication wiring consist of the mechanicals found in above ceiling spaces. This ceiling space is also used as a common return air plenum. A fire damper divides each floor from the main air return plenum as required by codes at that time. For offices and conference rooms located at exterior, cabinet air handlers provide conditioned air for these spaces.

Original Concept

As years passed, and with the desire to upgrade the top two office floors in the Vanderbilt Tower, the time came for a complete renovation. Traditional total renovation programs meant complete removal of all walls, floor finishes, ceilings, lighting, ductwork, mixing boxes, and power circuits, and systematically replacing with all new mechanicals, ceilings, walls, and finishes. The mass removal of the entire ceiling system however would mean exposure of the asbestos fibered fireproofing to not only construction personnel but possible exposure to dust from the construction area to the rest of the building served by the HVAC system.

At the time of complete removal of the ceiling it was suggested that removal of the existing fireproofing and replacement with new fireproofing was possible. In recent years, with costs of asbestos removal, handling, and disposal charges rising, the price for a complete removal of all materials, including fireproofing, and
providing new fireproofing, lights, ceilings and HVAC work was estimated at nearly $39.00 per square foot,

**Traditional total renovation programs meant complete removal of all walls, floor finishes, ceilings, lighting, ductwork, mixing boxes, and power circuits, and systematically replacing with all new mechanicals, ceilings, walls, and finishes.**

well out of reach for a competitive renovation budget for first class office space.

**The Value Engineering Study**

Onondaga Savings Bank approached a consulting engineering firm for a new direction to the project. With the cost of total removal and total renovation out of range for a competitive budget, several studies were made to determine cost saving alternates to total removal and renovation. The final study focused on the suspended drywall and tile ceiling, which, if stripped of its tile surface, and if the existing light fixtures could be modified, could provide an effective barrier for existing asbestos fireproofing left in place. A second layer of drywall could be overlayed below the existing drywall once lighting fixtures were locked in place and mechanicals could be relocated in a new ceiling plenum space below the new drywall ceiling. New floor to ceiling clear height would be 8 feet from finish floor to underside of ceiling, leaving approximately 1'-0" of clear height for new mechanicals now located in this space.

**The Value Engineering Concept**

After some initial study of the ceiling system it was determined that tile finishes could be removed exposing the original drywall surface. It was also possible to spot locations of fasteners of the drywall to the original suspended metal grid above. Lighting fixtures presented another problem, but were able to be delamped and locked into place once power was disconnected. At this point new furred drywall ceiling finishes, taped and sanded, were applied without interference. Clips for hanging a new suspended ceiling were able to be set into the original suspended ceiling frame by using extra length drywall fasteners. In several areas however, because of past renovation projects, the original drywall ceiling and frame had been removed. A new drywall ceiling and metal suspended frame had to be installed in these areas to provide continuity of design. To protect personnel from exposure of these open areas, protective barriers, trained personnel, and specialized equipment were used to control dust.

**Time and Cost Considerations**

Construction of the renovation project of the seventh and eighth floors took an average of 120 days from start to finish. Final room layout dictated the final placement of the new suspended ceiling, and special care was

**With the cost of total removal and total renovation out of range for a competitive budget, several studies were made to determine cost saving alternates to total removal and renovation.**

given to the design at the perimeter of the new suspended ceiling to permit the operation of existing pivotal windows.

Costs were tabulated from construction costs and were in the range of $14.76 per square foot for ceiling modifications, removals, protective barriers for spot locations, and a new drywall and suspended ceiling with mechanical and electrical work. The success of this method will vary with the construction techniques from building to building, but provides another option to consider when complete remodeling is desired, and exposure to asbestos containing material is a possibility.
### Table of Costs

#### Itemized Costs Before VE Based on 10,000 s.f.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Demolition</td>
<td>$15,750.00</td>
</tr>
<tr>
<td>Removal of Asbestos Fireproofing</td>
<td>99,372.00</td>
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<tr>
<td>Handling and Disposal of Fireproofing</td>
<td>77,986.00</td>
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<tr>
<td>Testing and Air Monitoring</td>
<td>39,565.00</td>
</tr>
<tr>
<td>New Spray-on Fireproofing</td>
<td>73,700.00</td>
</tr>
<tr>
<td>New Suspended Lay-In Ceiling, HVAC, Lighting</td>
<td>83,558.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$389,931.00</strong></td>
</tr>
</tbody>
</table>

**Cost Per Square Foot**

$38.99

#### Itemized Costs After VE Based on 10,000 s.f.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selective</td>
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</tr>
<tr>
<td>Selective Removals of Equipment and Protective Barriers</td>
<td>34,000.00</td>
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<tr>
<td>Testing and Air Monitoring</td>
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<tr>
<td>Drywall, Furred On, Entire Ceiling</td>
<td>12,834.00</td>
</tr>
<tr>
<td>New Suspended Lay-In Ceiling, HVAC, Lighting</td>
<td>83,558.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$147,615.00</strong></td>
</tr>
</tbody>
</table>

**Cost Per Square Foot**

14.76

**Total VE Savings**

$242,316.00

#### KEY

1. Existing Glass and Aluminum Wall
2. Existing Precast
3. Existing Fireproofed Steel Beam
4. Existing Wire Hangers 4'0"OC
5. Existing Main Channel
6. Existing Sub Channel
7. Existing Drywall Ceiling
8. Existing Ceiling Tiles Removed
9. New ½" Deep Channels 4'0"OC
10. Sleeve Anchor with Hook 4'0"OC
11. New Wire Hangers 4'0"OC
12. New Main Channel
13. New Sub Channel
14. New 2'x2' Lay In Mineral Tile Acoustic Ceiling 8'0" from Floor
15. Gypsum Drywall Soffit and Light Gauge Frame 20" Clear
16. Existing Plaster Soffit
17. Typical Air/Light Troffer in Place with New Gypsum Ceiling Furred Over

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16 Value World, Apr./May/June, 1990
Mind Mapping Workshop

by John L. Robinson and Bryan J. Beasor

John L. Robinson is a value engineer for the U.S. Army Corps of Engineers, Kansas City District. He has a BSME from the University of Missouri at Rolla. He has worked with VE at the Corps for over four years. He was on the steering committee responsible for the start up of the MO KAN DO Chapter of SAVE in Kansas City. Since then he has been the chairman of various committees, Chapter Secretary/Treasurer, Vice President, and now President of the Chapter due to the recent relocation of Bryan Beasor, elected President.

Bryan J. Beasor is the Training Manager for Union Carbide Coatings Service Corporation in Indianapolis, Indiana, where he has worked in employee involvement and VE for the past five years. His "hands on" experience has been in leading teams on quality improvement and problem solving in several Union Carbide plant locations.

Bryan was president of the MO KAN DO Chapter of SAVE in Kansas City for two years. Achievements include a degree in BSME, professional engineering license in Indiana, and a first degree black belt in Taekwondo.

The purpose of this article is to share with SAVE members the results of a workshop conducted at the 1989 International Conference in Indianapolis. These results will be used to assist the MO KAN DO Chapter when developing the 1991 Conference for Kansas City.

On Monday afternoon of the Conference, Bryan Beasor and I, John Robinson, presented a new tool to a group of about 100 value practitioners via a workshop. The tool was a very simple one which Bryan learned from a magazine article, then shared with me on the phone. The new tool is called Mind Mapping and is described in detail in "Use Both Sides of Your Brain" by Tony Buzan.

Mind mapping is based on some of the basic functions of the brain such as; use of keywords, free association, and imagery, all operating in a non-linear mode. It is a technique of writing that allows you to document your thought process. The thoughts can then be easily recalled since they are written in key words that are connected by association in a non-linear format. This format triggers the imagery function of the brain to assist recall.

After a brief explanation about how this simple tool works, how it can be applied to our jobs, and our personal lives, the audience was asked to split into four groups for a hands-on exercise (unfortunately, due to room limitations, we could not accommodate more groups).

The objective of the exercise was to give some hands-on experience as well as to give us (MO KAN DO) some valuable information to use in the development of the 1991 Conference. The question posed to the groups was, "What would you like at the 1991 Conference?"

The mind maps that were developed had many common lines of thought that are representative of the thoughts of the membership as a whole. The following items highlight what the membership would like at the Conference.

**Accommodations**
- Provide a map to the hotel.
- Directional signs in the hotel.
- Better food.
- Morning aerobic program.
- Accommodating pool hours.
- Tennis courts at or near the hotel.
- Non-smoking hotel rooms.
- Airport shuttle.
- No downtown location.
- Hotel that accepts Diner's Club cards.
- Host city Chamber of Commerce welcome package.

These results will be used to assist the MO KAN DO Chapter when developing the 1991 Conference for Kansas City.
— Have conference at a local college.
— Large enough rooms for the presentations.

Participants
— More diversity.
— Large number of participants.
— More customers.
— Younger participants.
— From other groups such as, designers, estimators, and other societies.

Exhibitors
— More exhibitors than in the past.
— Ones that interact.
— More vendors to VE/VA/VM.

Cost
— Let spouses and other family attend at a discount.
— Offer more incentives to come. For example, lower air fare and hotel rooms.
— Have sponsors like McGraw-Hill or General Motors.
— Lower registration fee.
— Accept Diner's Club cards for the registration fee.

Sessions/Speakers
— Speakers from outside SAVE.
— International speaker as a key note.
— Maximize audience participation.
— Have an after-round-table discussion on VE.
— Presentation on buzz words.
— Presentations that have a lot to offer.
— Mind Map session to improve SAVE.
— Better information from the speakers.
— Try to attract new users by offering a one day "how to" seminar.
— More presentations on overcoming the difficulties of the job.
— More open forums to give the participants an opportunity to interact with the organization.
— More topics.
— Speakers from varied disciplines.
— Papers for all presentations.
— Document the presentations by audio and video. These could be purchased at the bookstore.
— More films
— Have a time for sharing examples and success stories.
— Want to know more about VE legislation; the strategy behind it and the politics.
— More insight on selling VE.
— How to negotiate VE.
— Learn how to obtain long term commitment.
— Explanation of how VE relates to TQM, JIT, and other techniques.
— More hands-on.
— Plant tours.
— Technical tours.

— More new people making presentations.
— Breakfast, lunch and dinner presentations.
— No 6 a.m. meetings.
— More opportunities to get acquainted with each other.
— Abstract of presentations to give better description to the participants.

Entertainment/Recreation
— Cocktail reception.
— Sporting event for the members to participate.
— More recreation time to get to know each other.
— Dinner theater.
— Bar-B-Q.
— Local tour guides.
— Informal events.
— Pool party.
— More family time.
— Incorporate seasonal events or attractions of the conference location.
— Luau dinner.
— Ball game.
— CONFERENCE TO BE FUN!

General
— Emphasis on the host city theme or motto.
— Start the Conference on Saturday.
— 40 hour workshop credit for attending.
— More publicity.
— More news articles to sell VE.
— Conference to count more for certification.
— More bulletin boards with more information on them.
— Set up a computer bulletin board for information exchange.
— More advertising.
— More diversity, be flexible.
— Better information about the Conference.

These results will be reviewed by the MO KAN DO Conference Committee, and wherever possible, the ideas will be incorporated into the 1991 Conference. The MO KAN DO Chapter is also organizing a focus panel discussion under the direction of J.C. Boyers for the 1990 Conference in Baltimore.

J.C. will be facilitating something that has never been done before, a value analysis of a SAVE Conference. J.C. has put together a “management” team made up of members from the National Business Office, SAVE Board of Directors, and the MO KAN DO 1991 Conference Committee. This team will develop a FAST diagram of a conference at the end of the January 1990 Board of Directors meeting in Chicago. The MO KAN DO Chapter will then quantify the functions before the 1990 Conference in Baltimore. At the 1990 Conference, the “customer” panel will be formed by some 30 plus SAVE members. This panel will vote on the importance of the various features of a conference. This information will be used to determine value mismatches in the conference. The functions associated with these
mismatches will be brainstormed by the MO KAN DO Chapter to find alternatives to incorporate into the 1991 J.C. will be facilitating something that has never been done before, a value analysis of a SAVE Conference.

Conference to better satisfy our customers, the membership.

Bryan and I would like to express our sincerest appreciation for the overwhelmingly positive response to this workshop. We will use the valuable information you provided to its fullest.

Principles of Value Analysis/Value Engineering
A Videocassette

The Lawrence D. Miles Value Foundation, in cooperation with North Carolina State University, has produced a 34-minute presentation to introduce the concepts and benefits of Value Analysis. Topics covered include:

- The Definition of Function—the heart of value analysis
- Application of Function Analysis System Techniques (FAST)
- The Job Plan—a structured problem-solving process
- The use of Team Dynamics

Application of VA methods are shown in four diverse areas: a development program, an overhead cost problem, a construction project, and a more detailed step-by-step case history of a familiar industrial product.

Send your order to: Price
Society of American Value Engineers, Inc. $145.00
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Northbrook, IL 60062 Non-members 97.50

If you would like a copy of the handouts from the workshop, please send a business card to:
ATTN.: John L. Robinson
Value Engineering Office
U.S. Army Corps of Engineers
Kansas City District
700 Federal Building
601 E. 12th Street
Kansas City, MO 64106-2896
Practicing Value Management

by R.V. Gopalakrishnan

R.V. Gopalakrishnan is a Bangalore-based process consultant.

Of all management methodologies, value management (VM) is reckoned to be the most fundamental and intensive in approach for unearthing unnecessary costs and ensuring the needed functional performance in goods produced. VM originated as "value analysis" in the purchase department of a US company nearly four decades ago, when Larry Miles — now hailed as the "father" of value analysis/value engineering — procured many substitute materials which performed the functions of scarce materials reliably — and at lower cost!

This technique of value improvement, viz, effecting the needed functional performance at an appropriate cost, spread like wildfire in the sixties to government departments and public and private enterprises in developed countries; it became known by several names such as value engineering, value assurance, value administration and value control.

The umbrella term, value management, came into more prominent usage in the late seventies; its practice as a "small group activity" — through teams of managers across functions, coordinating sub-teams of operating level supervisors and circles of shopfloor personnel — has proven its utility in many Indian enterprises in the eighties and is poised to gather momentum during the nineties.

Success Factor

The VM team approach is simple and it does work, resulting in easier, larger and quicker gains. One of the key factors for its success has been the tapping of managers' participation in solving an organization's most important problems and in pinpointing its most attractive opportunities.

The mental and emotional involvement of team members becomes contagious as the team meets regularly and goes through the information-sharing, speculative and evaluative phases of its VM project systematically. In my interactions with thousands of managers in hundreds of VM teams across many enterprises — both in the public and private sectors — quite a few instances of better value from managers' participation emerged. Some examples:

The conditioning of team-members: When a team gets constituted on a specific project, it is natural for some team-members to have inhibitions and reservations but as the team matures, such aspects evaporate.

A VM team formed to look at electricity consumption in a large process industry had the electrical engineering manager as the team leader with the managers from production, technical services, quality control and others as team members. At the first meeting, the team leader declared that nothing much could be done to reduce electricity consumption. It was the production manager who prodded him and the other team members by saying that quite a lot of opportunities existed for conserving electricity. "We could, for example, increase the batch-size in the mixing mills by 5-10% for the same power, we could avoid the reworking of batches by upgrading operators' skills, etc.,” he said. Enthused by such a positive outlook, the team went on to achieve substantial electricity conservation — saving over Rs 30 lakhs in the first year itself.

Improving idea-fluency among managers: During an idea-generation session in a public sector unit, about 25 managers in four VM teams generated as many as 400 ideas on alternate ways of performing specific
functions. When they were asked for a feedback as to what they felt about the idea-generation process they all clapped their hands in admiration and their spokesman said: "This is the first time anyone has

At the first meeting, the team leader declared that nothing much could be done to reduce electricity consumption.

explicitly asked us for our ideas!" No doubt, managers can improve their idea-fluency if they get periodic opportunities, such as monthly review-meetings to "ideate" freely.

Reducing the "alienation" of managers: At the second periodical VM review — held four months after the formation of a VM team — a deputy team leader, then a manager of the technical services department, confided in me (an outside facilitator) that he had a few more ideas "up his sleeve" which he had not shared with his VM team! "What is the use of giving it to them when my earlier ideas, submitted to the management, have not seen the light of the day?" he asked.

Managements should increasingly separate the three processes — viz. tapping employees' suggestions, accepting some of them for awards and implementing the accepted ones. Imagine a managing director saying: "Your suggestions are welcome — as long as they are feasible." He is bound to get fewer responses, as compared to a contrasting invitation for "any idea, however wild it may seem." Many managers do not get a timely feedback on their suggestions submitted upstairs; no wonder they feel alienated.

There are also instances where managers, now perceived by the management to be in the "also-ran" category, have exhibited extraordinary leadership of their VM teams, yielding significant value improvements in their projects. Their commitments to their teams' efforts have been highly beneficial to the organization in areas such as increases in capacity utilization, etc.

Manager's teams involving circles of shopfloor personnel: VM teams coordinate the efforts of VM circles comprising shopfloor personnel. In a public sector heavy engineering unit, the VM team working on critical areas such as energy consumption, and welding costs could tap better value by coopting four energy circles and nine welding circles of key employees in their most important shopfloors.

This process of involvement induced the much-needed awareness in these areas among employees across and down the levels. The results were amazing: an 11% reduction in energy consumption in the first year of such efforts, near elimination of 'idle' running of the machines, improved capacity utilization of stress relieving furnaces (the number of heat-charges reduced by over 20% by better planning and bunching), upgradation of welders' skills, thus eliminating rework, and larger mechanization of welding processes.

Managers participation in productivity bargaining: A VM team was formed in a process industry to improve plant capacity utilization at a time when the next long-term settlement with the union was due. The team had rounds of direct talks with their key personnel on the shopfloor on their needs for improving capacity utilization — and thus got to know what was in their minds!

These interactions helped the VM team to suggest to the management, among others, a "package deal" by which the employees would get additional money and facilities, such as more bathrooms and dust-recovery systems, in return for an enhancement in capacity utilization. The management felt that this homework done by the VM team stood them in good stead during its final rounds of negotiations with the recognized union.

Recognizing VM team efforts: Many top managements issue an office-order to the effect that VM team efforts have been initiated on specific areas — thereby giving formal recognition to the VM teams. Their support is visibly reinforced again at the periodic VM reviews through VM steering committee members.

Half-yearly and annual VM review meets recognize the efforts of the various VM teams and help to reorient their priorities for the immediate future. Prizes are given to the best-performing teams, sub-teams and circles. In a public sector enterprise, the best VM teams were happy to receive books — and the best circles their wallets — from their chairman and managing director.

In a private sector engineering company, cash-prizes were awarded to the best VM-practicing factories over the first two years. Presumably due to the complexities involved in equitable cash-sharing, they have gradually moved over to shields, trophies and other non-monetary awards.

Tapping the collective wisdom of managers: It was Henry Ford, who said: "Coming together is only a beginning; keeping together is progress; and working together is success."

The VM team approach should tap the collective wisdom and knowledge of managers across functions in selective areas. For this approach to succeed, top managements should pledge their support visibly — by approving every year the most appropriate problem opportunity areas for VM projects. The most concerned managers should constitute the VM teams and the team-members should be encouraged to interact regularly. They would also do well to coopt sub-teams and circles down the line. The VM steering committee should provide appropriate facilitation to the VM teams' efforts through periodic reviews by coordinators — and recognize the best-performing teams.

Such a cross-linked small group activity among managers is bound to be stimulating, creative, satisfying and enriching — not only to the individuals and the teams, but also to the organization.
Value Engineering in Today's Rapidly Changing World

by Richard G. Bradyhouse, CVS

Richard G. Bradyhouse, CVS, is Technical Manager Producibility at Black and Decker Corporation. He graduated from Loyola College, Baltimore, MD. During his career he has been Industrial Engineer, Purchasing Manager, VE Manager and Operations Manager for the R&D Pilot Factory.

He is a frequent speaker on Design for Manufacturability, Creativity, Rationalization of Components and a variety of VE topics. He conducts workshops in the US, Canada, and throughout Europe, operating his own consulting business when he can.

Dick is a very active member of the Society of Mechanical Engineers and SAVE. He was President of the SAVE Chesapeake Chapter and national Director of Career Advancement.

Larry Miles laid the keel, hoisted the sails and guided this ship for many years. Now, it's up to us to keep her on a steady course as we head into the rapid currents of world competition, with change all around us.

What course should we set?

A course of strict adherence to “classic” VA or course “Nouveau,” a course dedicated to keeping pace with the progress around us. Don't get me wrong; I don't want to water down anything Larry formulated. I do want to grow and expand his technique in areas vital to Product Growth and Value.

Today’s product needs to be:

- Higher in quality than ever before
- Easier to assemble
- Easier to manufacture
- Innovative
- Stylish and
- Represent true value

How can we enhance VA to accomplish this?

Techniques like:

- Concurrent engineering
- Design for simplicity
- Expert systems for checking productivity
- Design for assembly
- VE for quality improvement
- Rationalized design

I have gotten to the point where I perform a prediagnosis on the “patient” product to determine which techniques need to be applied to restore the product to healthy sales and profits.

Let's take Design for Assembly as a case in point. Four men permanently altered the field we play on. Their names are Sei Miyakawa, Geoffrey Boothroyd, Jerry Hock and Peter Dewhurst, the architects of DFA. Let's take a look at the effect of DFA on VA.

VA teaches us to use Pareto's Analysis (80% of the cost in a product resides in 20% of its parts). So if you want to work smarter instead of harder, you will concentrate your workshop time on these high cost parts. This technique assures that if you run short of time and can't complete all parts, you are guaranteed a good result because the other parts, like screws and washers don't cost much and, therefore, have little effect.

DFA turns the coin over and reminds us that in the world of assembly, “all parts are created equal.” In other words, it can cost as much to assemble a washer as it does to assemble a $10 molding. In fact, if the washer is less than 2mm thick, it could cost more. Since assembly is the largest labor cost in a product, this is important.

DFA, on the other hand, ignores part function and is weak in applying creativity to solve the assembly problems it has identified. VA, by keying on a parts function, uses the function as a spring board to a more creative way of performing the functions needed in a product.

For this reason, I have merged both techniques to obtain superior results for my company. Competition today is keen and we need to increase our skill in VA and complementary techniques if our companies are to beat the competition.
The study of value engineering in Britain has to date been extremely limited. In the United States however, it has been a prominent technique that has been widely used since the end of the Second World War, while in Japan there are now some 250,000 certified value engineers practicing this cost saving technique. It was against this backcloth that I began my study of VE in construction which eventually led to my winning the 1989 FIABCI award. The award was a three month visit to the United States.

For the first three weeks of my time in the USA I worked with Smith, Hinchman and Grylls, a construction management consultant with a separate VE division, (the largest in the States). I was based in its Washington, D.C. office and divided my time between visiting and interviewing other VE consultants in the area and investigating old VE studies. For the interviews I had a standard set of questions which examined work done, methodology used and results produced. I very quickly discovered that the practice of VE was very far removed from the theory. It is said, for example, that the cornerstone of VE is the analysis of function. By examining the studies I found that this methodology, so revered by The Society of American Value Engineers, was not used. In addition, all current literature points to an ideal study being carried out at the 10% design stage whereas most US studies are in fact at 35%.

Another aspect of American construction management I found surprising was their cost control method. As a quantity surveyor I was naturally interested to see how VE relates to cost control and was amazed to see square foot estimates on projects at tender stage. They had little or no data that they could later base variation orders on, neither did they have any method of checking what was included in a contractor's tender. Most of the people I spoke to agreed that cost control was one of the biggest problems of construction management.

The other aspect of my first three weeks work was analyzing old VE studies to find the level of implementation of proposals put forward by the VE team. All the VE consultants I had spoken to were convinced that the cost savings put forward by them were capable of saving millions of dollars. However, none of the consultants actually followed up on the studies to see which proposals were actually implemented. This work was painstakingly slow as it involved phoning the project manager (if you could trace him) and going through the proposals with him finding out what was rejected and why. I did, however, have limited success and would roughly estimate that implementation was in the region of 30%.

During these three weeks I learned about the use of VE methodology in practice along with the nature of the projects and the types of proposals put forward. I noticed that there were two types of VE proposals; those which I classed as cost cuts and those which I labelled design proposals. The former class would tend to be items like omit planter boxes or substitute glazed tiles for paint and from a British angle offer little that the QS does not already do. The latter proposals, however, examined the concept and nature of the design and questioned its very ethos. These were generally the proposals that contributed the greatest cost saving but were most difficult to implement, particularly after 10% design stage when the design concept was already locked in. These were also the proposals that upset the architect the most. They did, however, require a thought process beyond that employed by the quantity surveyor in the normal course of his work.

Now that I had seen how the studies were put together in the next step was to see the actual VE studies being done. In almost all cases they take the form of a workshop where consultant architects, engineers and mechanical and electrical consultants from the VE consultant get together in a hotel, review the design and put forward proposals that save money. Generally the studies lasted five days and my next
month was taken up with attending four of these workshops.

The first study was actually a training workshop for a construction management company wishing to train their employees in VE methodology. They became the VE team and, working with a live project, reviewed the design under the supervision and instruction of Al Dell'Iso. The study took place in the Holiday Inn in Springfield, New Jersey and provided a useful insight into the educational level of the trainees. Qualified estimators and experienced construction managers, for example, had no idea of life cycle costing, cost planning or design economics. I interviewed all team members present and found that even after the workshop they were skeptical about VE and felt it was something that they already carried out in the normal course of their work.

Study number two was again in a Holiday Inn but this time in Washington, D.C. Unfortunately, the study did not work well. The main problem lay with the client which was a hospital administration with very strict design criteria. The design team had designed to standards which the VE team in turn were not familiar with. They produced cost reduction suggestions based on reducing the hospital administration regulations. The design team, therefore, wrote the study off as being a waste of time since the criteria could not be changed. Furthermore, all VE theory recommends that when proposals are presented to the design team at the end of the study it should not be done in a challenging manner. This, however, was not the case with one member of the team and a stand up argument followed.

Thirdly, the study was carried out too late in the design process. The design was 50% complete and the design team was in no mood to start making changes. As a result they rejected most proposals on the basis that the redesign costs were greater than the savings. Also, the VE team knowing the extent of the design work did appear to hold back from putting forward proposals that may have been worthy of consideration. Finally, the VE team did not work together when producing their proposals but merely worked to their own discipline so losing the benefit of team synergy.

My third workshop was in New York in a governmental building in Lower Manhattan. The project was a police precinct in Central Park and was an excellent study which rekindled my now lagging enthusiasm for VE. Here the VE consultants did work as a team. They approached the design team with delicacy and tact and the team in turn responded with even more cost saving suggestions of their own. The project was a complicated refurbishment, but difficulties were overcome to produce savings of 20%, most of which the design team were keen to implement. The problem with this project was twofold in that as it was a listed building, New York City was keen to have it visible to the public, but the police department was concerned about security. There was a serious conflict of interest so the VE team had to try to answer to two masters both of whom were present at the study. In addition, successful VE lies in the examination of concepts which are difficult to formulate on a refurbishment when the presence of an existing building limits the number of alternatives possible. The team, however, unlike the previous study, did examine the very concept of the project even to discussing abandonment.

My final workshop took place in Phoenix, Arizona and was unusual in that the VE team and the design team were one and the same; that is, the design team was using VE methodology to review their own work. (This is in keeping with one school of thought in the States which suggest this is the best way to carry out a study.) The biggest problem with this study was that the client, a government agency, did not really care about the cost of the project. A certain amount of money had been allocated based on an original estimate and they were determined that they were going to spend it. The project was an archive storage building and had been designed with three levels of underground car parking. Arizona is not a state that is short of space and the VE team leader battled for two days to get the architect to agree to delete the car park and build it on level land across the road. She did eventually agree to redesign only to be told by the client that they wanted it underground. They had no logical reason for dismissing the VE proposal but as they had the money to spend they saw no reason for saving it. This is, of course, typical of many government departments and stresses the point that not all projects are suitable for VE: the client must be committed for it to be effective. Another interesting point about this study was that it was carried out very early in the design process at less than 10% design. The proposals put forward were high cost reduction items that I believe could have substantially reduced cost without affecting quality, had the client been committed. The early stage of the design allowed this greater scope for cost savings.

On all four workshops, I interviewed all members of both design and VE teams as well as taking part in the studies. I learned an enormous amount about how to, and how not to, conduct a VE study. The single most important fact I discovered was that it was not the methodology of the study that was important, but how the VE team and design team interacted with one another. I found that good interaction produced far more positive results than any complex VE technique. With regard to using the design team to do their own study, I feel that it requires further investigation, but certainly many of the personality problems can be overcome by doing so.

All things considered, VE can significantly reduce construction cost without reducing quality. In the UK at present there are consultants claiming that they carry out VE studies and it is my opinion that these claims ought to be treated with caution. VE has undoubted benefits but the American system is not without its problems and the straightforward implementation of it would not be feasible in Britain.

Attempts at it would only give VE a poor reputation which it does not deserve. Any QS in this country is capable of a cost cutting exercise but that is not VE. VE examines function and eliminates unnecessary cost without affecting quality. Further research is required into the solution which can provide a viable alternative to the US system. One thing is certain, the QS is already ideally placed to take up the role of VE manager. The question remains to be answered: is he prepared to take up the challenge?
Success with VE Program Requirements

by Robert H. Rossman, CVS

Robert H. Rossman, CVS Fellow, is a Partner in Kempter-Rossman International of Washington, D.C. Bob has been involved in directing DOD VE Programs, assisting companies and Government agencies in establishing VE Programs, performing VE Studies and teaching VE in Workshops for 22 years, and participated in more than 1000 VE Studies in the past 16 years. This VE experience includes construction, highways, defense and commercial equipment, and in VA of processes, organizations, budgets and procedures. He has an MSME Degree with Honors, and has performed classroom work toward a Ph.D.

Value Engineering (VE) in Government contracts, particularly with the Department of Defense (DOD), and more directly with certain Military sub-commands, is easy to perform.

Most contracts for production items lend themselves to a minimum of ten percent approvable VE changes. Many production items can be improved in many other areas of vital concern, e.g., performance, quality, reliability, producibility, et al. while offering contract savings of 20 to 40 percent.

Motivation to Perform VE

Several agencies of the Federal Government include voluntary Value Engineering Incentive Clauses (VEICs) in many of their contracts for production of goods. The Federal Acquisition Regulations (FAR) notwithstanding, these clauses are included in few Federal contracts that the regulations require. The ability to reduce the cost of Government through motivation of its contractors has rarely been utilized. And, through late actions and poor explanations of disapproved submittals, the motivation of contractors, who had been willing to invest resources to perform the voluntary VE actions, has quietly disappeared.

The horror stories spread through contractor organizations concerning individual treatment (or mistreatment) by their Government contracting and program/project management counterparts has kept contractor participation very small, even as a percentage of the small number of contracts containing the voluntary contract clause. What contractor, having been “robbed” of his/her ideas, can continue to be motivated to participate? And, which other contractors, knowledgeable of Government treatment of those who had participated in the VE program, want to risk time and resources in a program with such a “poor reputation” for fairness?

Participation Minimal

Thus, through the years, many production contractors have made a conscious decision not to participate in the voluntary VE program.

However, there are many contractors who have no knowledge of VE and/or no ability to perform in-house VE studies which lead to cost reduction and product improvement. In addition, there are many Government contracting officers and program/project managers who, through direct or indirect means, indicate their unwillingness to support VE actions by their contractors.

Thus, through the years, many production contractors have made a conscious decision not to participate in the voluntary VE program.

The result of all of these impediments to progress and change is that only a few Government contractors participate in the voluntary VE program to reduce the cost of Government.

The quandry which faced those few Government personnel who were interested in making Government purchases more cost effective, and products more efficient, went beyond motivation of their contractors. Once a Government organization achieves the reputation of being “anti-VE,” even though it happened 20 years ago, it is difficult to entice its contractors to invest their own resources in a “losing cause.”
Requiring VE

For more than 25 years, the DOD has had another tool available to obtain contractor participation in the VE Program: The Value Engineering Program Requirements Clause (VEPRC or PRC). Until recent years, this tool, which pays the contractor to perform VE studies in specific areas of the contract, was seldom used. If a contractor was not motivated to perform voluntary VE, it just was not done.

Recent efforts within the DOD have greatly increased the use of the PRC. One particular U.S. Army activity, the Communications Electronics Command (CECOM), under the impetus of the Army Material Command (AMC), uses the VEPRC in every contract exceeding $10 million in value. The objective is to stretch budget dollars, permitting purchase of more and better equipment for the troops. Through the strenuous efforts of CECOM’s VE Program Manager, Al Paley, and his staff, results are now being obtained, where no VE actions could have been anticipated in the past.

The VEPRC requires that a contractor perform VE, generally lists those items or areas where VE actions are desired, and pays the contractor to perform the necessary work as a line item of the contract. In many cases, the contract requirement includes the presentation of a VE Workshop, led by a Certified Value Specialist, early in the contract period. In addition to reports on progress, CECOM has established a goal of 10% cost reduction in the contract. The contractor is required to submit Value Engineering Change Proposals (VECPs) on the Engineering Change Proposal Forms (DD Form 1692), and a VE Proposal Sheet (format provided by CECOM). Potential Life Cycle Cost (LCC) savings are also solicited.

Sharing Savings

For any VECPs approved by CECOM, the contractor receives (holds in his/her contract) 25% of the net savings to the Government from the instant (present) contract. Savings are also shared with the VECP proposer in concurrent contracts in which the VECP can be implemented, and in any future contracts where the VECP is included, which are awarded within three years after implementation of the VECP (in the first end item of the instant contract).

CECOM also has a variance from the FAR which permits them to share LCC savings with the proposer for three years instead of one year, where the end items are spare parts.

Thus, the sharing potential for CECOM contractors is quite large. In some cases, contractor earnings from VE can equal or exceed the profit of the original contract. For any CECOM contractor to participate (and succeed) in these additional earnings, it requires only that the contractor make a commitment to perform the VE effort in the contract, and to obtain the services of a CVS who is capable of performing the necessary support and/or leadership effort, including a Certified VE Workshop on-site.

Case Study Example

In November 1989, TADIRAN Communications, an electronics developer and manufacturer in Israel, held a required Certified VE Workshop with me hired to lead the Workshop and studies. The equipment involved was a U.S. Army radio set. The contract was for spare parts. One additional U.S. manufacturer had a similar contract for the same parts.

TADIRAN had never done a VE Study, and few people in the company had ever heard of VE. The VE PRC required that the Workshop be led by a CVS; I was selected because of my knowledge of the VE requirements of the FAR.

The attendees included 14 full-time engineers, technicians and contracting personnel. An additional group attended the opening sessions, participated on a part-time basis during the studies, and attended the presentations of results during the following week. This additional group included the Program Manager and Director of Quality for the contract, and the Director of Contracts for the company.

An additional 24-hour Seminar-Workshop was held during the following week, directing particular effort at Life Cycle Cost Analysis and cost estimates directly tied to the results of the Workshop studies previously accomplished.

Three VE Teams were established for the Certified Workshop, and all concerns of the CECOM contract PRC were addressed. Detailed work continued after the normal working day.

Within three weeks after conclusion of the VE Workshop, seven VECPs were submitted. These VECPs proposed savings in the instant contract of almost $5 million. The potential LCC savings to the Army, over a three year period, amounted to approximately $84 million (more than double the price of the instant contract). The total nonrecurring costs associated with detailed design, development, prototype testing, first article approval, drawings, and technical manual changes were estimated at about $1.4 million.

Six of the seven originally submitted VECPs were recommended for approval to the Army Program Manager, with the seventh requiring additional testing to prove the concept.
One month after the first VECP submittal, an additional five VECPs were to be submitted to CECOM, with about 12 more in the pipeline. The additional five VECPs had similar instant contract and LCC savings.

All of the first twelve VECPs resulted from the work performed in the VE Workshop.

The VECPs which are approved by CECOM can also be implemented in the concurrent contract (with a different contractor) producing savings sharing with TADIRAN, and additional LCC savings to the U.S. Army.

If the first seven VECPs are approved by CECOM, the TADIRAN share will amount to about $900,000 on the instant contract (25% of gross savings less development and implementation costs); something near $1 million in the concurrent contract; and at least $16 million in sharing LCC savings (plus some additional LCC savings from the concurrent contractor).

Negotiation of savings and percentages are still required, but this company is now quite ready to pursue VE in all of its contracts and products in the future.

Should TADIRAN earn $18 million as its share of VE savings from this work, that would be the equivalent of winning $180 million in new contracts, based on a 10% profit margin, and this would be achieved without having to expand facilities, labor pool, insurance, et al, which might be required after winning such a large contract.

A company which performs VE under the voluntary VE Incentive Clause would receive 50% of the net savings in the instant, concurrent and future contracts instead of the 25% offered in the VEPRC.

**Conclusions**

The Federal Government, faced with very large budget deficits, and the DOD, faced with large potential budget cuts, need the help of all contractors to reduce budget expenditures and to stretch dollars

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**Any Government production contract is susceptible to a saving of 10% through VE efforts.**

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available to meet commitments. Contractors, faced with less Government and DOD expenditures for goods and services need the share of savings available from performing VE to maintain or improve their gross profits.

Any Government production contract is susceptible to a saving of 10% (sometimes much more) through VE efforts.

A company commitment to perform traditional VE with the help of a knowledgeable and proven CVS, who has led and assisted in many VE studies, is all that is needed to reap the bounty of VE, while helping our Government stretch its budget dollars.
“Thunder”

Bridges Bland and Otherwise

by Tom King, CVS, Fellow

Let me be a devil’s advocate today.

Bridges are becoming a little bland, don’t you think? Truly, one’s spirit is rarely moved by many of the bridges we are building today. Kind of bland. Saying that, I will quickly add that a couple of my favorite VE friends are competent bridge engineers, and I want to keep them friends.

So, my comments are meant to be reflective; not pejorative. Just think about them.

In all candor, most of the bridge replacements underway today have little imagination. They appear as a series of concrete medial dividers fused end to end. It would be no large surprise to learn that they served dual purpose as barriers on the everpresent highway reconstruction project as well as featured in bridge designs.

Perhaps nostalgia is getting the better of me. As a lad I can remember the romance of the covered bridges; functional for their time but rendered obsolete with the passing of the horse and buggy. Also I remember Pittsburgh’s Bridge to Nowhere*, it gave us mill towners something to poke fun at besides ourselves.

And who among us with an ounce of passion cannot appreciate the mystic aura of suspension bridges such as the Golden Gate and the much sold Brooklyn Bridge.

Rising majestically the cables are skyward and back again gracing the skyline.

Just being there, you could feel the excitement.

You took pictures. You painted them. I am not tempted to take many pictures of bridges today.

It is true that I never understood how so much paraphernalia was needed above a bridge to support that which traveled beneath it. But, no matter, it was appreciated nonetheless.

The practical choice of bridge design is, of course, affected by span, traffic volume, weight considerations and natural conditions. Yet, somewhere, somehow, in today’s new bridge designs have we gone beyond compromise in the art of combining functionality with aesthetics for a reasonable cost?

Pragmatists might argue that we have indeed helped, not hindered, aesthetics by removing all that unnecessary, unnatural monument of steel and cable. Good answer. Further, isn’t it now possible to get a better glimpse of the shore or landscape below? Good answer. Especially if you are in a Greyhound bus or elevated monster machine.

Well, perhaps.

Realize that in the final analysis, available resources can be a very mitigating factor. Life cycle, or maintenance costs, is another issue, I’m sure. Perhaps this is the rational thought process that makes a dream of another Golden Gate impractical and unlikely.

Well, we will take it as it comes, encouraging engineers to keep as much fun in bridges as possible.

Meanwhile, I will hold my camera in readiness awaiting the next Golden Gate.

* A bridge was built extending over the Allegheny River in anticipation of an expressway hookup from downtown Pittsburgh to Interstate 79. Unfortunately, the expressway project was delayed for twelve years while the bridge sat idle, unused.
BOOKS:

"Techniques of VA & VE (3rd Edition)" by L.D. Miles. This book, authored by the originator of Value Analysis and Engineering Technology, shows management and professional people specific steps to disciplined thinking, giving them 25-50 percent more efficiency—both in the quality and quantity of their mental work.

COST  Non-Member $36.00  Member $32.00

"Innovative Change, 101 Case Histories Value Engineering" by A.E. Mudge. This book presents step-by-step techniques and procedures in three parts; the first part discusses the theory and fundamentals of the crucial ingredients of program management, the second part details the application of the theory and fundamentals to a program, and the third part provides meaningful supporting data.

COST  Non-Member $37.00  Member $33.00

VIDEOTAPES

"Principles of Value Analysis/Value Engineering" The Miles Value Foundation, in cooperation with the Society of American Value Engineers and North Carolina State University, produced this 35 minute presentation to introduce you to the concepts and benefits of Value Analysis.

COST  Non-Member $195.00  Member $145.00


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"Keeping the Competitive Edge with Value Analysis" by Robert Brethen, President and Chief Executive Officer, Philips Industries, Inc. Mr. Brethen tells an exciting story about how his company has applied the tools of value analysis to achieve dramatic results in product enhancement, market share growth, cost reduction, and profit improvement. Philips Industries received the society's highest award—Excellence in Value Engineering for 1988.

COST  Non-Member or Member $20.00

"Manufacturing: A Competitive Weapon" by Al Mattaliano, Staff Vice President, Manufacturing, Hughes Aircraft Company. Mr. Mattaliano describes a revolution in manufacturing technology that is occurring at Hughes. The concepts and practices of just-in-time, expert systems, cycle time management, automated work instruction, flexible manufacturing, and computer aided design and manufacturing, integration are illustrated through actual example from the several manufacturing plants. The role of value engineering in this environment is identified.

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