

## IMPROVING CUSTOMER ACCEPTANCE OF VALUE ENGINEERING

Michael Koga, PE, CVS  
Pacific Division, Naval Facilities Engineering Command

James A. Dziekonski  
President, CIMS, Inc.

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Theodore C. Fowler, CVS, Fellow, SAVE

Michael Koga is the value engineering (VE) program manager of the Naval Facilities Engineering Command. He has held this position since 1982. He received his bachelor of science degree in Civil Engineering in 1965. He is a registered professional engineer in California and Hawaii. His professional experience includes assignments as a structural engineer with the U. S. Navy, civil engineer with the Federal Aviation Administration, and highway engineer with the California Division of Highways. His VE program received Department of Defense and U. S. Navy achievement awards in 1982 and 1990 and a Department of Defense VE program management award in 1986.

James A. Dziekonski, President of Cost Improvement Management Services, Inc., a Denver area based consulting firm. He was formerly Western Regional Manager, Value Planning, Joy Manufacturing Company; Corporate manager, Value Assurance, Kohler Company; Manufacturing Manager and Assistant Plant Manager, Thomas Industries; Design Engineer and Director of Quality Control, Ilg Industries and President, J & J Design Company. He is Vice President of the SAVE Rocky Mountain Chapter that he founded in 1978 and was president until appointed SAVE Vice President Finance in 1978. He has written and had published nationally and internationally numerous articles on Value. He has two industrial product patents and while with the Corps of Engineers developed the "Bow" and "Igloo" type covers used by military Field Missile unit

### ABSTRACT

This paper describes an improved design procedure that uses VE methodology and VE techniques to develop a design concept that is functional and incorporates high value materials, systems, and processes. Clients like the process and it insures that they will continue to ask for similar VE services in the future.

### INTRODUCTION

VE practitioners have focused on implementing VE proposals to reduce the cost of construction projects. In many instances, these VE studies were commissioned because of administrative and congressional mandates that require VE technology be incorporated in the procurement process. Most Federal agencies have VE policies, goals, and directives in their procurement guidelines and in their grant-in-aid programs. These VE policies are generally the result of congressional initiatives that codified the recommendations of audit or ad hoc committee reports that looked at VE as a way to reduce costs, improve efficiency and eliminate waste.

Many SAVE members spent hours of preparation, research, and testimony to convince congressional delegations and other organizations that VE is the tool to reduce cost, improve efficiency, and generally make the world a better place to live. OMB Circular A-131 which mandates that VE studies be conducted on a wide range of Federal procurements is another example of the success of these efforts. Other VE legislation being considered are House Bills HR 2014 and 133 that will make some of the requirements of A-131 a law. Project sponsors, facility users, design agencies and other elements of the procurement process responsible for executing Federal procurement programs often do not fully support these VE mandates and have become very adept at circumventing them.

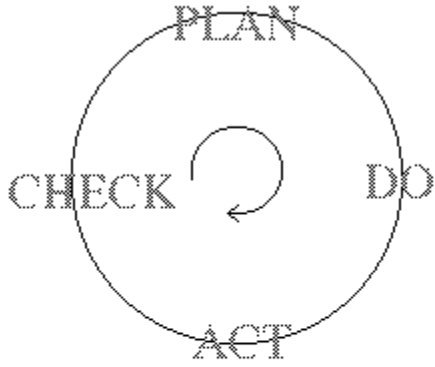
One common ploy is to report cost reductions that are normally part of the design process (particularly when the project is over-budget) as VE savings. Another is to make a determination that a potential VE study on a project will not be cost effective because the project is

routine, has been VEd many times before, or is a site-adaptation of a standard design.

Most of us active in VE know, however, that significant unnecessary cost can be found in all projects. The reluctance of project sponsors to fund VE studies and the fact that legislation like the HR 133 exist are an indication that we are not effective in educating our clients to the benefits of VE or the services we provide may not meet their needs and expectations. Our emphasis on cost, or what we believe is unnecessary cost, has led us to ignore our customer's wants, needs, and expectations. Forced deletion of many project amenities detract from the completed facility. Additionally, many VE practitioners don't have a full appreciation for the increased risk and higher maintenance costs assumed by owners when recommendations to design to minimum codes are adopted.

Many VE recommendations assume that any project designed to a higher standard than required by codes has unnecessary cost. Value Engineers are very adept at identifying these items and in getting them eliminated from projects without fully realizing that they are reducing safety and increasing risk. Even when VE teams correctly identify unnecessary cost their arrogant attitude often irritates designers and project sponsors.

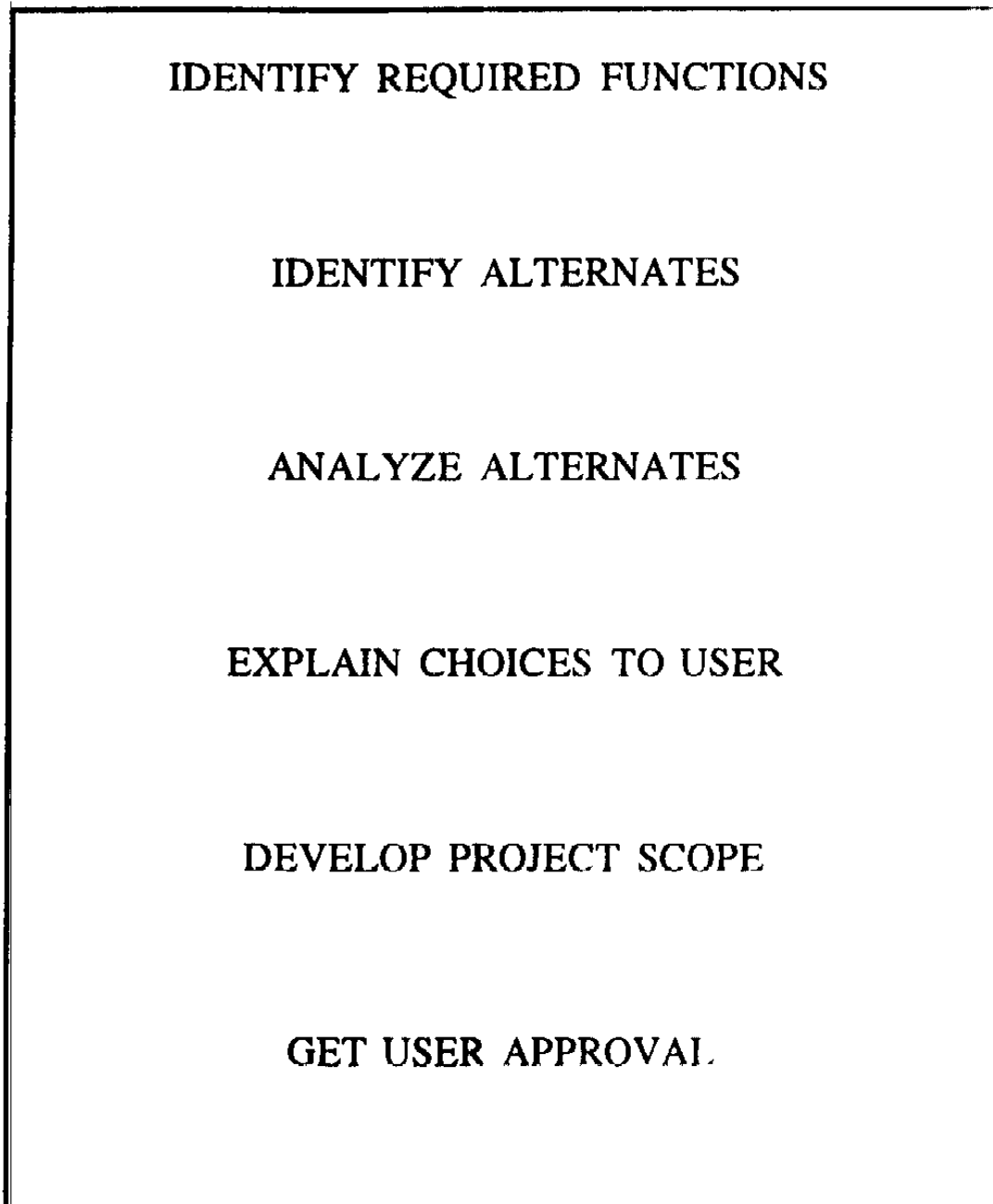
All of these factors have adversely affected VE programs. With the advent of the quality culture and strong statements by project sponsors that they, not the VE officer, are the sole arbiter of project requirements, made it evident that VE technology needed a new vehicle to be effective. Integrating VE technology early in the design instead of using it as a separate cost and quality check is one way to insure that VE remains an effective tool. VE technology used this way also eliminates redesign cost associated with conducting VE studies on completed or partially completed designs. The cost of redesign and the adverse impact of this redesign on execution schedules makes many project managers fight VE studies even if they know that a study can reduce cost.



In this sense typical VE studies violate one of the basic principles of the Deming total quality management (TQM) philosophy - the use of end of process quality control checks.

#### AN IMPROVED DESIGN PROCESS

We have started using an improved design process that incorporates VE technology in development of the design concept to improve the quality and timeliness of the product. This improved process, called **F**unctional **A**nalysis **C**oncept **D**evelopment (FACD), uses many iterations of the VE job plan. It starts with the identification of required functions and proceeds through identification of design alternates (speculation), analysis, development, presentation, and approval. As previously noted, the process is iterative and follows the TQM process of PLAN, DO, CHECK, ACT. The FACD team goes through the VE job plan several times with plenty of interaction with the facility operator in each loop through the job plan. The process starts with gathering of information and discussions with the facility operator, project sponsor, and other cognizant individuals.



**Figure 1 FACD Process**

The FACD team analyzes this information, prepares function evaluation and relationship diagrams and starts preliminary design sketches. The information is presented to the facility operator as soon as the information is developed. A meeting is held to reconfirm information gathered and get feedback on the team's analysis and preliminary design. This feedback is further analyzed, additional information gathered, and the design concept refined.

This iterative process continues until a satisfactory project scope and design concept is developed that can be constructed within project budgets. This iterative process is shown in Figure 1.

The FACD team normally includes the architect-engineer design team, the facility operator, representatives of the owner's engineering staff, VE specialist and project management staff (person who has responsibility for budgets and allocation of funds). It normally takes 10 days to proceed from initial client meetings to approval of the final project scope and design concept. Long work days, particularly for the architect, is the norm rather than the exception. The addition of roughly one week of pre-site visit effort and two weeks of post-study effort, brings the time required to go through the whole process to roughly 6 weeks.

**PRE-SITE VISIT INFORMATION GATHERING**

The FACD process starts with the gathering of information. An appropriate place to start is a review of the project description

and cost estimate, if any. This can provide a description of the facility requirements that the clients thinks he needs. The information must be evaluated and a preliminary cost (baseline cost estimate) prepared to determine if planned construction budgets are adequate.

Many technical decisions will be cost driven, so it is important that the team start the on-site phase with a preliminary cost estimate.

**ON-SITE PHASE**

The on-site phase of the FACD starts with discussion of the operations or work that the facility operator does. It is important that this discussion focus first on understanding the facility operator's business. A discussion of facility requirements should be started only after this basic understanding is obtained.

The team next determines required project functions using functional analysis or other functional evaluation tools such as FAST (Function Analysis System Technique) diagramming. These exercises, as in VE studies, are to get the FACD team to agree on project function. Client education is another use of these exercises. The results of the function identification exercises should be presented to the client for concurrence. Figure 2 is the result of a functional analysis session on a sewage treatment plant expansion.

The programming document called for plant treatment capacity to be doubled and features like odor control installed. The project was budgeted at roughly \$7 million, but the initial cost estimate prepared by the designer indicated that a plant expansion would cost roughly \$12 million. The FACD team evaluated the existing flows, plant capacity, and the operator's stated priorities.

The team determined through functional analysis that the operator's first priority was to meet the permit requirements. The client was happy that the FACD team helped them identify "meet permit", not "expand capacity" as their top priority. The team concentrated on providing redundant plant components so the plant could be maintained without violating permit requirements. This project scope was achieved within the authorized budget.

FAST diagramming is another valuable VE tool because it diagrammatically illustrates to the client how his basic function can be provided. Figure 3 is a FAST diagram for a gymnasium expansion project. The FACD team helped crystalize the client's thinking by identifying "improve image" as the basic project function. The identification of "improve image" instead of "expand facility" allowed the team to focus on making the facility "like a quality health spa" which is exactly what the facility operator wanted.

**FIGURE 3 NOT SUPPLIED IN THE PUBLICATION**

<b>FUNCTION IDENTIFICATION</b>			
<b>COMPONENT/PART/ITEM</b>		<b>VERB</b>	
<b>NOUN B</b>	<b>S</b>		
<b>ENTIRE PROJECT</b>	<b>MEET</b>	<b>PERMIT</b>	<b>X</b>
	<b>INSURE</b>	<b>REDUNDANCY</b>	<b>X</b>
	<b>INCREASE</b>	<b>CAPACITY</b>	<b>X</b>
	<b>CONTROL</b>	<b>ODOR</b>	<b>X</b>

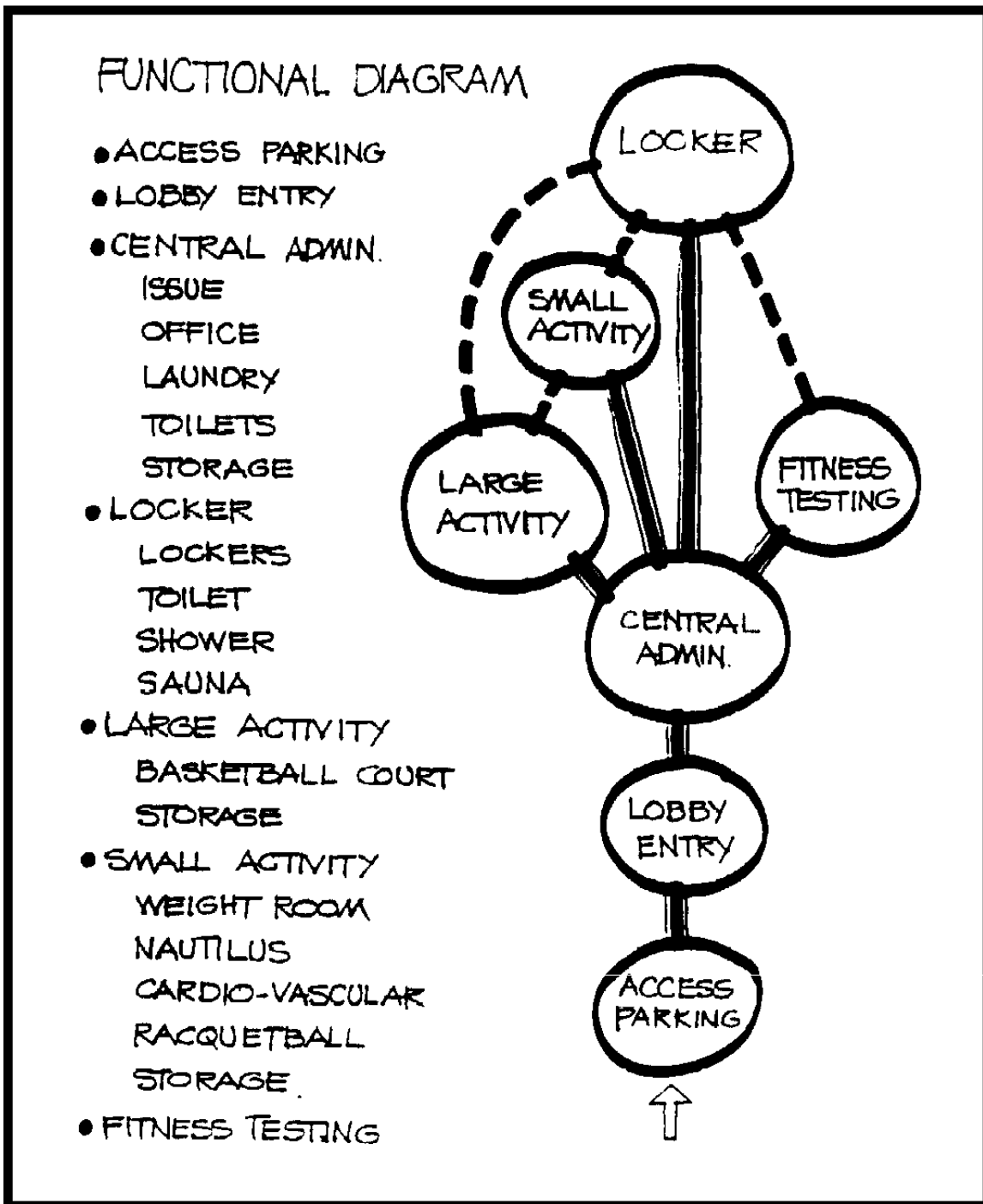
**Figure 2 Function Analysis for STP Expansion**

The full benefit of functional analysis and FAST diagramming techniques have not yet been realized because most design teams are not familiar with these tools and fail to fully understand their

power. Teams will let you lead them through functional analysis and even the FAST diagram, but feel that this exercise is not productive and the effort could be better expended working on the design. VE practitioners also fail to recognize that functional analysis and FAST can be used as quality control tools and are largely responsible for the failure of teams to use them for this purpose.

Many VE specialists also go through the function identification process by rote and develop standard analyses. We are all familiar with the product of this kind of functional analysis session. More VE for design teams and greater commitment to the full use of VE tools by value engineering specialists will allow FACD teams to better understand and use these VE tools.

FACD teams go on to develop function relationship diagrams (bubble diagrams), material flow diagrams, function priority charts, site analyses and other traditional design tools. Figure 4 is an example of such a diagram. It is important that the full FACD team participate in this phase of the process to foster understanding and team work. Teamwork and team spirit really improve when all design disciplines understand the logical basis for the design objective and are allowed to participate in its development. The value engineering specialist must work to develop this team spirit and encourage the whole FACD team to participate. If the VE specialist can't get the team to work together on this phase of the FACD, the cost to have the whole team participate in the opening meetings with the facility operator will be wasted.



**Figure 4 Bubble Diagram Physical Fitness Center**

Once the functional diagrams are developed the team can proceed to develop site plans, floor plans and other elements of the

design. The engineering disciplines should continue to gather site information and start preliminary coordination of utility requirements, circulation routes, and other aspects of the developing design. It is very important at this point to quickly develop a preliminary design concept to reflect the actual site conditions and the stated functional requirements.

Speculation sessions should be held as soon as each element of the design concept jells. The FACD is not a VE study and some of the VE methods you've successfully used on VE studies have to be modified to be successful. The format of "brainstorming" sessions used on traditional VE studies does not work well on an FACD. The design process moves rapidly and the FACD team will not wait to convene a large brainstorming session on all building systems. If you don't have a brainstorming session when a system is being debated, the opportunity to brainstorm alternate systems will be lost. Once the designer selects a system based on his analysis he will not want to retrace his steps and examine other systems. Alternate formats for the "brainstorming" session have to be considered because free flowing sessions found on VE studies are often not productive. Remember the purpose of the speculation and analysis phase of the process is to examine major systems not design details, consequently, managed speculation similar to that used in the normal design process is very effective. One method is to tape record design discussions for each of the major systems in the design concept. Designers are comfortable with the format and these discussions are an appropriate vehicle for "brainstorming." The VE specialist should recognize when one of these discussion sessions develops because they spring up spontaneously, quickly resolve a design issue, and are over. The VE specialist has to be there to prevent premature judgement from stifling ideas, make sure everyone provides input and restrain participants from selecting systems based on intuition. After alternates are presented and judged, he should summarize the discussion and assign topics for development. Documentation will suffer if the VE specialist is not present to control the process.

Analysis and development of design alternates should be done before the major systems are selected e.g., site plan, floorplan, structural system, grading, drainage, utility connections, environmental control, architectural finishes, interior electrical and other major cost drivers. Designers often select these systems based on experience rather than hard analysis.

The analysis and selection process and cost estimates based on this selection are needed to refine the baseline cost estimate. The emphasis at this point should be on quality and value rather than the lowest cost. The philosophy up to this point is to provide the client with high value, high quality, materials and systems. Many decisions after this point will be cost driven. It is therefore important to know the cost of the optimum facility.

Cost cutting may be required if the optimum facility can not be constructed within budget. Many design teams don't believe that it is possible to reduce cost without drastically reducing quality and therefore look at reducing project scope as the only way to reduce cost. The VE specialist will need high powered salesmanship to get the design team to bring the project within budget. Most design disciplines know where to find unnecessary cost in their designs. Cost models and design "rules of thumb" should be used to point out areas of opportunity and to encourage the design disciplines to mine these areas.

The VE specialist should work with the FACD team to explore additional areas of potential cost cutting if the design team can not bring the project within budget. The "blast and refine" technique is especially effective in reducing costs. All recommended cost cutting proposals must be reviewed with the client with a full explanation of the adverse impacts associated with implementation.

By the end of the fifth day the FACD team will have presented several refinements of their recommended project scope and design concept to the client. They will have refined the cost estimate to include design refinements and cost cutting ideas selected. The project scope and design concept will be very close to meeting all of the client's functional requirements or agreements will have been negotiated to resolve cost, budget, and performance incompatibilities. The team will therefore be ready to make a formal presentation of the recommended project scope and design concept.

### FORMAL PRESENTATIONS

A formal presentation of the final project scope and design concept is made to the client to make sure that he fully understands all elements of the project scope and design concept that he will be asked to approve. The presentation will include color graphics of the site plan with landscaping, floorplan, exterior building elevations, building perspective, circulation plans, black and white drawings of utility plans, FAST diagrams, functional analysis charts and other information previously presented in earlier working

sessions. This briefing should start with a review of the project functional requirements and briefly retrace the steps taken to develop the project scope and design concept.

Approval of the project scope and design concept can pretty much be assured because the scope and concept were jointly developed with these same individuals. Comments and requests for minor changes should be expected since this will be the first opportunity for the client to see the full project described in language he can understand. One successful approach is to describe room sizes by pacing off room dimensions rather than describing the room sizes in square feet. The FACD team should find similar descriptive terms to describe other aspects of the project.

### EXECUTIVE SUMMARY

A written narrative of the project scope and design concept described in the formal presentation is prepared and distributed for review. Copies of the executive summary are distributed to all signatories as well as members of the client's engineering staff. This document often has more detail than the information discussed in the formal presentation and should be carefully reviewed. The facility operator and upper level management are asked to read the narrative and to submit comments or changes that they want incorporated in the document. One or two days are given for this review.

A review meeting is usually held to resolve all comments submitted. These comments and the agreed action to be taken on each comment are incorporated in the final executive summary. The final design of the facility will be based on this document. Copies of the approved executive summary report are distributed to all signatories prior to the FACD team's departure. The distribution of the final executive summary concludes the on-site work.

### FOLLOW-UP DOCUMENTATION

A formal report is submitted by the value engineering specialist to document the FACD on-site activities. This report includes:

1. Copy of the final executive summary
2. Summary of design alternatives investigated with cost impact and if the item was incorporated in the design concept, or the reason for rejection.
3. Design and economic analyses for all investigated alternatives.
4. Minutes of all meetings (The VE specialist keeps minutes of all meetings he attends).
5. Results of functional analysis, FAST diagrams, bubble diagrams, and other function definition worksheets.
6. Creative idea list with idea ratings.
7. Baseline cost and final FACD cost estimate.

### LESSONS LEARNED

Feedback that we've received from clients and designers we've worked with on roughly 50 FACD studies shows:

1. Clients like the process. Clients say they like the feeling of ownership they get in the design concept because they participate in its development. They also are happy that they quickly see the product of their effort in a matter of days instead of weeks and sometimes months. One client that strongly objected to VE studies is a strong advocate of the process and regularly asks us to use it even on small projects. This same client has asked other design agents to use the FACD process. VE managers will find that the FACD is a good vehicle to incorporate VE technology in design. You will find clients asking you to use the FACD process rather than saying they don't need VE on their project.
2. Designers say they also like the process because they get a better understanding of client expectations and budget constraints. They also like the quick resolution of problem areas and the atmosphere of cooperation and teamwork during the FACD. They say that the team spirit initiated during the FACD carries through to final design.
3. We like the process because it has reduced our re-design cost.

### PROBLEM AREAS AND ROADBLOCKS

There are several roadblocks that have to be overcome before the full benefit of the FACD process is realized:

- 1: Project managers, design agents, and designers have to accept the TQM philosophy of continual improvement. The biggest roadblock to acceptance of the FACD process is the belief that the old design process was ok, so there is no reason to change. The "if it ain't broke don't fix it" mentality permeates many of our institutions. New design processes will not be fully effective even with upper management support if elements of the design process don't accept that improvement is necessary even if we aren't getting customer complaints.

As a related issue, it is important for VE to move into the main stream and be accepted as a normal part of design. If we aren't successful in achieving this shift, VE will continue to be a minor program that clients will continue to resist.

2. Design teams have to know more about the VE tools they will have to use. Improved VE training for designers can improve VE knowledge in the design community. Consideration should be given to reducing the length of the Module 1 training course or a new series of accredited VE courses that stress VE theory and de-emphasize workshop study time should be considered.
3. VE specialists should examine innovative ways to use VE tools at their disposal. Many formats used by VE practitioners are not suitable for the fast moving design process and have to be re-evaluated.