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VALUE ANALYSIS

A KEY TO LOWER COSTS IN ELECTRONIC EQUIPMENT

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The pressures resulting from lack of time and information force management, engineering, manufacturing, and purchasing decisions which are unnecessarily costly in the production of all products.

One method of avoiding this costly difficulty is through the use of Value Analysis or Value Engineering (the terms are often interchangeable). It can increase profitability of highly competitive products, or, in many cases, increase the quantities of military electronics provided per million dollars expended.

The use of Value Analysis is increasing daily as both commercial and military pressures make it more important to secure more and more reliable product or service performance for lower and lower cost.

What is Value Analysis

"Value Analysis is an organized, creative approach to the efficient identification of unnecessary cost; i.e., cost which provides neither quality or use nor life nor appearance nor customer features.

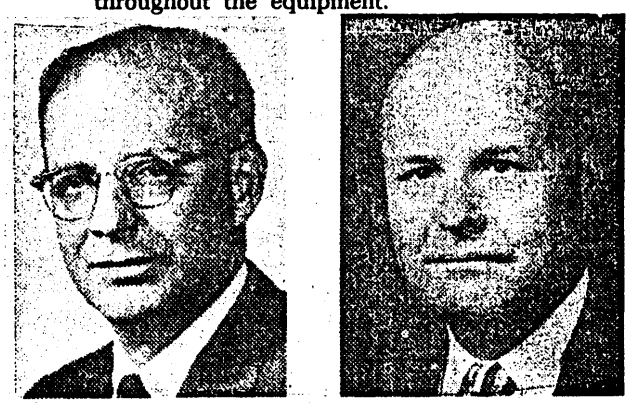
"Value Analysis results in the orderly utilization of alternative materials, newer processes, and abilities of specialized suppliers. It focuses engineering, manufacturing, and purchasing attention on one objective—equivalent performance for lower cost. Having this focus, it provides step-by-step procedures for accomplishing its objective efficiently."*

Its techniques are based upon several realities learned only by hard experience. Some of these realities are:

1. So much knowledge exists pertinent to the decisions which determine the product costs that it is impossible for the engineers in either design or manufacturing stages to be completely knowledgeable of every contributing factor or consideration. New approaches are essential. Because Value Analysis techniques are "search oriented," not "knowledge oriented," they offer excellent opportunities for solving cost problems.
2. A cause of much undetected and needless product cost is honest unfounded beliefs held by competent management people who have decades of experience. Value Analysis techniques recognize the force of these "roadblocks," and provide a means for finding them and dealing with them.
3. Another cause of unnecessary product cost lies in the fact that the best ideas simply were not thought of at the time decisions had to be made. The possibility that more could have been produced at any time later by better problem-solving techniques is inescapable.
4. Finally, every product—certainly every electronic product—is purchased by the user to accomplish a specific function or group of functions. All techniques of Value Analysis are centered around function. What does the customer want in "use" functions and in "appearance" (or esteem) functions? What are the lowest-cost alternatives which will reliably provide them to him? What search techniques will find the information needed? What areas of useful alternatives lie just beyond the "roadblocks?" What approaches embodying designs, construction or materials that are simpler, more reliable, and more inexpensive can be found to do the same thing?

Electronic components and systems—especially for military application—lend themselves well to intensive Value Analysis. Note some of their basic characteristics:

1. They are totally functional in nature.
2. These functions are furnished by specific hardware.
3. Functions and hardware are evenly matched: one component for each job; groups of hardware for groups of functions. Most sub-functions can be tested separately and can be supplied by a variety of means.
4. Extensive tooling and knowledge already exist somewhere in either the United States or abroad for making high-grade functional components very efficiently and at low cost.
5. Manufacture of electronic equipment is highly repetitious. The functions of support, shield, rectify, filter, amplify, resist, provide resonance, provide capacitance, etc., repeat themselves throughout the equipment.



Left: J. H. Martin, manager-value engineering, Ordnance Department, General Electric Company, Pittsfield Massachusetts. Right: L. D. Miles, manager-value service, General Electric Company, Schnectady, New York.

Keeping these characteristics of electronic equipment in mind, let us look at the basic system of Value Analysis.

The Basic Steps of Value Analysis

The basic steps of Value Analysis are probably well known by now but are worth reviewing briefly in the present context:

1. Identify the function clearly.
2. Evaluate the function in terms of cost; how much does that function cost in dollars on other types of equipment.
3. Analyze alternative means for reliably accomplishing the same function. Formal Value Analysis has established 13 specific techniques for doing this.

Clear identification of the function of each electronic component or system which has a determinable cost will itself promote better, lower-cost solutions. It also sets the

*L. D. Miles, Techniques of Value Analysis and Engineering (McGraw-Hill Book Company, New York, N.Y., 1961).

equipment up as integers of function. If the solution of the problem is to retain all functions at lower cost, the equipment becomes solvable integers of function.

Evaluation of functions in dollars is extremely important. It forces men to think in terms of value. Dependable evaluations of most functions or groups of functions can usually be made by men who have received one or two weeks of Value Analysis training in the technique.

Having established by the evaluation (not analysis) process the reasonable appropriate cost for the function, the hard core of the problem is laid in clear view. Now the question is—how to accomplish the function for its dollar value, which is often one-half or one-third of the historical or intended cost.

A system of 13 techniques is used for this purpose. The techniques are simple, direct, and, when used with skill and training, produce the desired results.

For example, one of these techniques is labelled, "Avoid generalities—get down to specifics." Answer these questions: Precisely what function is required? To what degree? Under what conditions? What are five or ten alternative means for accomplishing it? What does each cost?

Another technique which forces simplicity, clearness of thinking and practical creativity is called, "Blast, Create, then Refine." Eliminate what is in immediate view so that the mind is no longer channeled and so that thinking is totally different, more effective directions are not stifled. Direct thinking to the basic considerations at hand.

This technique can be painful to the designer. His solutions to the design problem are his creations. In arriving at them, he has expended great effort using extensive professional training. Studies were made; money was spent. The designed and manufactured product has truly become part of the individual. To him, the idea of "blasting" is inwardly repugnant.

These reactions are emphasized here because the whole technique of blasting, creating, and then refining is an intellectual one. It can be extremely productive when people are mentally trained to understand and use it.

To summarize, the function is first brought into clear focus. Then the possible means of providing the functions (or sub-functions) are reduced to simple terms. The necessary complexity is then added. Alternative means for achieving the complex requirements is then analyzed.

Value Analysis of Electronic Equipment

Let us examine several case histories of Value Analysis at work in the general area of electronics. We have a small radio frequency transformer about twice the size of a grain of wheat and costing 39 cents. It is used in large quantities. The normal function of a transformer is to effect a useful transfer of electrical energy between two coils. For that purpose, one coil of wire is brought in close physical proximity with another coil of wire. Let's examine the structural function of this product. Basically, the problem is to hold reliably two coils of wire in an appropriate physical relationship. In this case, "holding" was found to be accomplished by winding both coils of wire on a very small spool. Four almost microscopic holes were then drilled in the ends of the spool, and the four necessary ends of the two coils were threaded through and pulled out of these holes. Study showed that the two coils of wire accounted for less than 10 cents of the cost. The cost of the spool, the drilling of the ends, and the threading of the wires through the holes in the end made up the bigger part of the cost.

BLAST: Use only the two coils of wire. Put the two coils on a toothpick size piece of wood or plastic.

CREATE: Here are some alternative means to the same function. Discontinue drilling the spool ends and the subsequent threading of the fine wires through the holes. Use a drop of adhesive to hold the wires in place. If the spool ends are not to hold the wire, they will not be needed, and so we can discontinue using the spool. Use a straight piece of suitable plastic or insulator material, wind on the coils, and secure the wires by a drop of appropriate adhesive.

REFINE: By using only the coils indicated in the "blast" step and the small insulator and adhesive to maintain them in rigid relationship to each other, the electronic function can be accomplished at considerably less than half the original cost. However, we are now short of a means of supporting the assembly in the equipment. To provide for this, an additional small mounting part can also be secured by the drop of adhesive. The new cost is 19 cents, contrasted with 39 cents. The annual production cost is now $38,000 instead of $78,000.

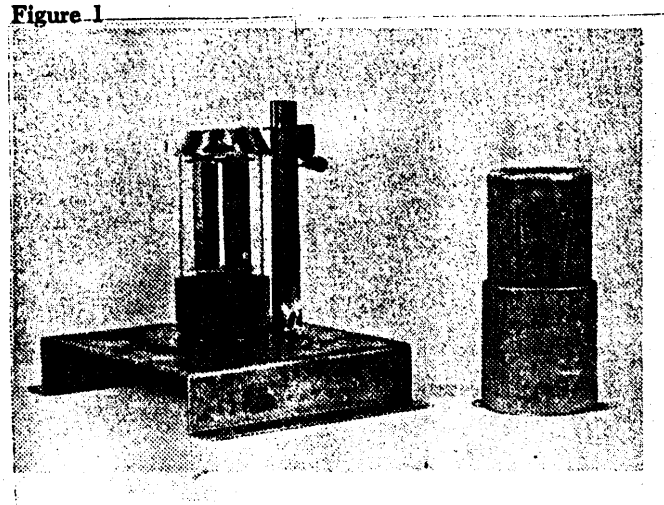
General Electric's Ordnance Department at Pittsfield, Mass., has amassed considerable experience using Value Analysis on complex electronic and ordnance systems developed and produced for the Navy. The department builds the inertial guidance and fire control systems for the Polaris program, as well as shipboard radar antennas and acoustical torpedoes. In recent years, millions of Navy dollars have been either saved or put to more efficient use through aggressive Value Analysis programs. Some of the more recent examples of successful application of Value Analysis are as follows:

An acoustical torpedo control panel is subjected to considerable shock and vibration. It was therefore considered necessary to provide heat sink shields around each electronic tube. The function: to dissipate quantities of heat while providing at the same time a mechanical hold down for the tube itself when it was stressed by shock. Actual analysis of the circuitry and exhaustive testing proved that the expected heat level would never materialize and that the heat shields were unnecessary. As a result, only the hold-down function was required and this was provided for 27 cents (see component on left in Figure 1). The original shield (see component on right) cost $5.57 with 12 shields required for each unit.

In a signal and control circuit for an underwater missile, several stages of amplification or filtration were designed where a single or double stage would have sufficed and provided the function. This is somewhat akin to using a hi-fi amplifier and connecting it to a $3.00 low resolution speaker. In other words, the hi-fidelity was not actually necessary for the end use in this particular case.

In the case of a G-E ERMA computer for use in machine accounting Value Analysis studies determined that a trim potentiometer being used was of extremely high

Figure 1



reliability and quality and had, in addition, a high degree of linearity. Minute movements of the adjustment barrel would give proportional, linear changes in the voltage. Upon analysis, the actual function required was determined to be that of providing adjustments in voltage to a predetermined level, whereupon the potentiometer was locked. No linearity was necessary, although much of the cost of the potentiometer was tied up in providing this high degree of linearity.

In electronic systems Value Analysis, we have developed a slogan which pinpoints the heart of much of the problems: "will a 5 per cent resistor provide the function as satisfactorily as a 10 per cent resistor at twice the cost?"

At a recent Value Analysis seminar held at Pittsfield, Mass., an unusual case was uncovered. The function in question was to provide light inside a gas-filled pressurized waveguide section used on a Navy radar antenna. The first design was a complex lighting device costing $75. It illuminated a vernier dial inside the unit. The difficulty with this device was that should the small lamps burn out, the whole assembly would have to be dismantled possibly at sea under adverse conditions. During the seminar, the students originated a simple solution which utilized the "light-carrying characteristics" of a lucite rod. A $3 sightglass was fastened into the bulkhead. The lucite rod was attached to a pipe plug and fastened near the sightglass. A 50 cent flashlight was used to project a beam of light at the end of the lucite rod. The light coming out at the other end of the rod played onto the vernier calibrations, thus providing very adequate illumination at 25% of the original cost.

Ordnance Department builds various radar antenna for the Navy's Bureau of Ships. One simple but interesting Value Analysis idea was incorporated in a di-pole collar used to hold the wave guide assemblies used on the antenna (see photo Figure 2). Harry Martin, manager

Figure 2

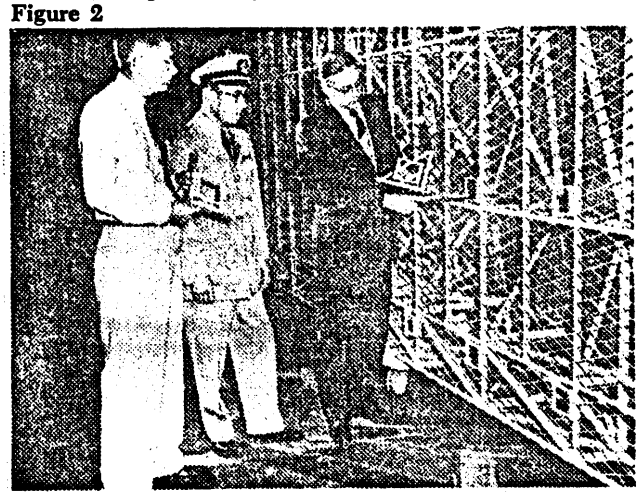
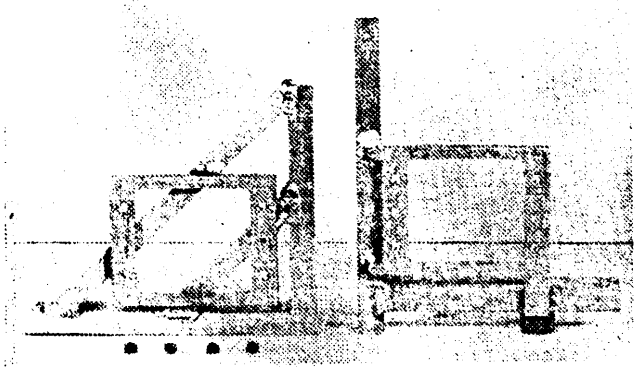


Figure 3



of the Department's Value Engineering group, is holding in the photograph the original design of the di-pole collar. Installed on the antenna is the new design. A close-up view of the device is seen in the second photograph (labelled Figure 3) The component on the lift shows the old design; the right-hand view is the new design. By modifying the design to include three integral tabs, the function is retained, but the machining of two diagonal supports plus four welding operations have been eliminated. Reduction in cost is more than 60%.

In another case, an expensive cable clamp costing $5.65 was reduced to a cost of 82 cents by completely eliminating the machining operations necessary in the manufacture. (See photo Figure 4) This was accomplished by using a precision investment casting produced by Precision Metalsmiths, Inc. of Cleveland, Ohio.

A rather staggering cost case has resulted from perfecting a broaching process, using a corrosion resistant material and working well with a specialty supplier. (See photo Figure 5.) Originally the piece, used in a Polaris fire control, was made from carbon steel, pinion stock. Cost for each has been reduced from $3.03 to 18 cents—a 93.5% reduction in cost without compromise to performance or reliability. Such a small and seemingly insignificant change on an unimportant piece has represented a saving of $948,000 to the U.S. Navy on this contract.

It should be emphasized that in all of these cases, all of the functions required of the devices is secured. Value Analysis should never be employed to reduce cost at a sacrifice to quality or reliability unless that quality or reliability is unnecessary. It is, rather, a sound professional method of facing business cost/performance problems squarely, securing new and creative alternatives to those problems so that the same quality or better quality will be secured for much lower cost.

Figure 4

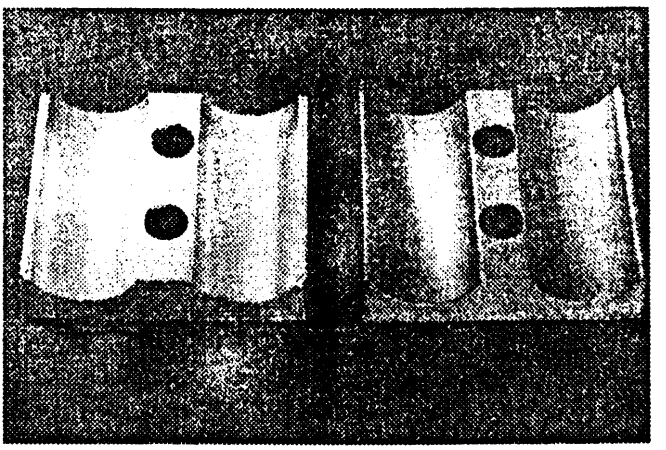


Figure 5