

VALUE ENGINEERING, LTD. MEETING  
CHARING CROSS HOTEL, LONDON  
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(Portion of program presented by L. D. Miles)

Thank you, Howard.

Ladies and Gentlemen:

Since the years when you people of Britain stood alone and bought with your blood, time for us to awaken to help preserve the freedom of people to think, to work, to live, and to die, I've always had the hope that sometime I could help to repay that debt. Who knows? Now may be the time.

### TRADITIONAL PREDECISION IS DIFFICULT TO HALT

In the design and production of buildings and in the development of services and products, certain forces in the human stream of life predecide the direction, just as surely as the tide predecides the drift of a boat. It's time that we study this tide-- to deal with it in a step by step manner. This tide is the nature of man; it will not change. But timely use of the anchor and a different set of the sail will greatly increase the results from the ship. A new thinking process must drop an anchor and stop the tide of predecision, then set a different sail. It will be our pleasure this morning to develop some of this new thinking process-- this new anchor, to stop traditional predecision. We call it Value Analysis or Value Engineering. I will use the two terms synonymously.

A new laboratory was built for nuclear work. It was necessary to shield adjacent areas from radiation. Learned men who have succeeded in these fields designed the building and its protection. Its specifications called for an enclosing ring of concrete outside of the building. It was to be fourteen feet high and seven feet thick. This was the appropriate and traditional manner of protecting adjacent areas. Construction men in the past have proceeded to build it as designed. This time, after getting bids and finding the cost was £ 17,000, they started to let the contract. But something dropped an anchor; in this case it was not a new system of thinking but rather the Works Manager. He knew the changeableness of scientists. He was afraid they might move the laboratory and leave him with the concrete. So he said, I'll approve it providing you agree that you will take the concrete with you if you move the Laboratory. This anchor, from a different viewpoint, caused the necessary thinking. The principles of Value Analysis were used. The result was a beautifully grassed-over earth mound fourteen feet high and fourteen feet thick, which cost £ 1700. Because something more was introduced, something that hasn't come in the normal stream of life, a better product was provided at

one-tenth of the cost, on a quantity of one, in the scientific field. What had happened was that first the drift was stopped. Secondly, a different sail was set.

#### VALUE ENGINEERING HALTS PREDECISION--CAUSES DIFFERENT THOUGHT

On the opposite extreme are appliance parts, repetitively made in large quantities. This cold control goes into refrigerators. Three million each year were made and sold for a period of time. Sales price pressures reduced yearly sales to one million. During that period engineering, manufacturing, and purchasing people took special action to remove every possible penny of cost so that the men dealing with the control said, "Not one penny of cost can be removed without reducing quality--and we don't want to reduce quality." Then Value Analysis techniques were used on it. All of the quality was kept and it was improved somewhat. No new technology was required and here it is! Now it is a little more accurate and costs somewhat less than half! What happened? The natural forces of systems of human beings were met, these forces were stopped, different thinking was caused, and alternatives were provided for decision.

Let's take the plastic cover. It costs 3d. With a million, the remaining production, that was £ 12,000 a year. Twelve thousand pounds for what? For the function of covering the control to exclude food.

#### FUNCTION BECOMES THE FOUNDATION

Now the question is: Is that an appropriate amount to pay for the covering function? In this case, to shorten a very interesting story, research techniques were used to develop alternatives; it was found that for one penny or £ 4000 a year, a flat piece of odorless plastic could be used. This would be £ 8000 less.

Now the alternative was provided to the engineer. He considered it and said, "No." Asked by his manager why, he said, "Because a molded plastic part is the proper way to make a cover." This would cost £ 12,000 per year!

We knew that we must incorporate something into the system to influence the flow of human thinking.

What should money be spent for? Research developed the answer. Only for customer function--only to accomplish customer needs and wants. The cover cost £ 4000; the molded part cost £ 12,000. The customer wanted the function of a cover. He did not want a molded part.

There are two types of customer functions: the functions that perform a "use" for him and functions that "please" him, causing him to buy (aesthetic or esteem function). They are both worthy of cost. Nothing in the value technology tends to minimize the

importance of the aesthetic function, yet it does tend to bring it into clear focus. The engineer was asked, "Would the £ 4000 cover perform as well as the £ 12,000 one?" He replied, "Yes; no question about it!" Then the one remaining question: "Did anyone ever buy one refrigerator of any make because of the lock-up of the £ 8000 back inside of the refrigerator over the ice cubes?" He said, "No; I'm sure they haven't because they never see it." It was very clear to us, although we didn't know how to deal with it, that there are three elements which take money: one element is performing a "Use" function that the user wants and needs; another is performing "Aesthetic" functions which we often call "Esteem" functions which cause the customer to like this and to buy this; A third element of cost is to conform to the customs of ourselves, the designer and the manufacturer. In this case there were £ 4000 to accomplish the "Use" functions the customer wanted, zero to accomplish the "Esteem" functions that he wanted, and £ 8000 per year to conform to the engineer's customs. The £ 8000 is unnecessary cost.

If Value Engineering principles are sound; if we are dealing with the forces that determine the results produced by human beings, we will observe the same benefits in the military, in administration, in procedures work, etc. Let us look at an assembly which is the spot focuser on the radar screen. The assembly costs £ 40. Illustrating Value Analysis thinking, the question becomes; "What is it doing that the user wants?"

The user wants to rotate four small rheostats costing six shillings each; two on one axis, and two on a right angle axis. It is adjusted by eye so tolerances are wasted. We have then, £ 40 worth of equipment moving 24 shillings worth of plus or minus 30 per cent tolerance rheostats! Now an anchor is dropped. Stop until some different thinking is done! Why so much cost in this device with so simple a function? More information then brings out the fact that it is because the resistors must turn three hundred degrees to go through their range, thus gears are required. Isn't a modified rheostat which will cover its range in 90 degrees obtainable? Yes, and they will cost one shilling more each. Now a different problem is in clear view. The engineers are given a different input. They now provide a very simple mechanism in which the movement of one lever provides the variation. Within three days the cost of the rheostats was increased from six to seven shillings each but the assembly for controlling them was reduced from £ 40 to £ 3.

What has been done here? The natural forces were understood. They were met by a different system. They were dealt with. Different thinking was caused. This thinking produced different alternatives. All of the function was accomplished but for 1/10 of the cost.

## NEW THOUGHT SYSTEM IS VALUE ANALYSIS

This "anchor" which stops the wash into the rocks of disastrous cost, and the system that produces a new set of the sail to escape these rocks is what we call the system of Value Analysis or Value Engineering.

It is both frustrating and life preserving...frustrating as the tightening anchor chain stops the drift; life preserving as new thought causes a different sail to be set.

Now we have many problems. Any good engineer will say, "That's nothing different from what I've been trying to do; nothing different from what our manufacturing people are trying to do; nothing different from what our process men are trying to do. We do this every day. Is there a difference?" And my answer is: "Very definitely there is a difference."

Many techniques are developed into this system to accomplish one purpose, the efficient identification of unworking, unnecessary cost, the efficient identification of "roadblocks" and the effective dealing with them.

It is a specific inclusive system. When getting identical performance for very much lower cost is important, it will accomplish the results needed years sooner and at a fraction of the cost.

What happens when this system is learned and is used?

Although the system should often be used before initial design, it will be more graphic if I illustrate by first showing economically successful products, then follow by showing the even better thinking which was produced by the introduction of the Value Engineering principles.

The motor shield costing £ 2 reduced to 8 shillings...

The handles for electronic gear reduced from £ 3 to £ 1...

The switch-blades for switchgear from £ 1 to 3 shillings...

The mounting for the calrod heater in a furnace, from 8 shillings to 1 shilling...

A filter circuit in electronic gear from £ 16 to £ 2...

The studs in porcelain insulators which are made by the million to suspend power lines, from 1/4 to 1 shilling...

With their enormous quantity, it meant £ 25,000 each year of lower purchase cost.

By coincidence, in the J-bolts which hold the weight of a heavy television unit, a reduction in purchase cost of £ 25,000 per year resulted.

Condensers, dissipating heat on refrigerators--a little less than half...

A double nut, from 23 shillings to 7 pence--one fourth the cost.

Perhaps that's enough. If I have correctly communicated, I have shown you that we are not dealing with reductions in cost by trying to do it the same way, but do it better; but rather, have a different approach. Of course, it is worthwhile to also continue to try to "do it the same way" but "do it better". Cost reduction practices have been and are the lifeblood of any business; but what I am saying is that now we have a different system...a system that approaches the problem differently, gets different thinking, and very often accomplishes all that the customer wants for a half, a fourth, a fifth, or a tenth of the cost.

This is done by providing more precise information on just what he does want, by developing better alternatives which use existing materials and processes, and by dealing with the human factors so that new thinking comes into the decision making.

In the Value Engineering System, we have put together--from all sources--the techniques and approaches that are needed. Take the telephone for comparison...that is made up of perhaps a thousand parts, all put together in one system for one purpose. If one or two of the thousand parts are left out, the results won't be reduced by one or two thousandths, they may be cut in half or out to a tenth, or total functions eliminated. By comparison, we found when we studied the available processes for identifying unnecessary costs that there were many good elements in place; good design engineering practices, good manufacturing practices, good cost reduction, good work simplification, good purchasing, but we found there were some elements lacking. These lacking elements drastically reduced effectiveness. The Value Engineering System has included them. In it are (1) techniques with which you are very familiar, (2) techniques which are entirely new--just a few of them, perhaps a half dozen, and (3) dozens which are familiar, modified.

#### "FUNCTION" APPROACH CENTERS THINKING ON CUSTOMER

It was found that the best way to minimize traditional thinking; i.e., thinking about the machines we have, the size of our factory, the know-how we have, the past jobs we have that worked well and the hundred other factors from the past that propel us toward traditional decisions; is to give great personality to "function". This centers thinking on "what the customer wants" and produces so much different thinking that soon we are dealing directly with the important factors of the job. What is each item for? What does it do? Its purpose is to support ten pounds. What is it for? To conduct one hundred amperes four inches. Always, in addition to the function, there is a specification: Weight supported under what conditions? Current conducted under what conditions? In doing this, each function is spelled out and evaluated.

Function is divided in many ways: "use" and "esteem", basic and second-degree...i.e., basically, what is the function of this porcelain insulator stud? Why does the user buy it? He buys it to support the weight of the power line. But it has several other functions which are necessary to cause it to perform that basic function well. It must resist corrosion; it must resist wear; it must resist shock; perhaps resist rifle bullets of small boys. These are called secondary functions.

Now in working with function we have a framework wherein we can ask: What is the "appropriate cost":..that is, the minimum cost at which it can reliably be accomplished..for the supporting function? Of course, this is always based on supplying the function where and when needed, using the known technology and possessed skills.

Surprisingly, costs so put together are often a third or a half of the usual costs. On individual parts--often a tenth. In military gear, over-all about one-third of traditional costs become practical.

#### ONE NEW TECHNIQUE--EVALUATE THE FUNCTION

One of the new techniques is known by the name of evaluating function in sterling. That means: "Look at one function. Determine the lowest cost of accomplishing it--assuming for the moment there was no other function." In the example of a switch blade, one basic function is: Conduct one hundred amperes four inches. What would be the lowest cost? Of course, we would compare to the cost of a copper wire four inches long. This would give a maximum cost of 6d for that function. The second basic function is "openability". It must be opened manually once or twice a year so that the service man can see that it is open, and feel safe to work on the circuit. "What would we have to do to that piece of wire to provide a mounting around a bolt? Perhaps we would use a flat wire, perhaps we would bend it and we would have to have a longer wire. So, in this case, the second function was evaluated at one shilling, giving a total of 1/6d. Evaluating this function in sterling requires somewhat more skill -- I call it evaluating functions approximately. Now the functions have been evaluated by comparison.

This should be done, and can be done, before the initial design.

For contrast, let's look at what happened when this B 1 switch blade was designed. One part was a sand casting. Molds were built. The company had the equipment and was happy to use it. Jigs were built to braze in the blade. Now a usable item was produced for B 1. Its costs were as good as competition and it performed its function well, so it is a good item.

## APPROACH, KNOWLEDGE AND MOTIVATION REQUIRED

The Value Analysis techniques have supplied the new approach, have shown how to secure new knowledge and now provide effective motivation. Men are, however, not motivated by any statement unless they believe it credible. The process of evaluating the functions by comparison has provided to them a feeling of credibility. It has shown them what the results of their thought should produce in design per unit of sterling.

What happened after the 1/6 evaluation of functions for the part costing £ 1? People involved are shocked. They re-think it. The answer comes forth in a brass pressing. It could have come forth in another form--or many other forms. Now the cost became 3/. It could have cost 3/ several years ago, but it had grown from the usual traditional thinking process. The different thinking process propelled it toward the efficient way of reliably accomplishing the function for much lower cost.

You folks are good business men or you wouldn't be here and you probably now say, "Well why do you accept 3/ when you said it's only worth 1/6?" I'll answer the question to save you asking it. It is because we might just as well cooperate with the feelings of people when we can! People are generally very pleased when they can, without embarrassment, remove three-fourths of the cost and have a totally interchangeable part of obviously a little better quality. They don't worry about the fact that it still costs double the value of the functions.

Now what will happen--and it happens over and over--is that in another couple of years competition tightens down and this will then be accomplished for 1/6d.

In this entire approach what we have done is to clearly divorce from all minds everything except what is important--"what does the customer want?" We have said he wants function which we divide into two classes: the use and the esteem or aesthetic. We have divided those functions. We have looked at each one separately and illustrated the process of evaluating each function individually. In this evaluation a credible value is set for each function, preferably before design work is started. The result is that any approaches that would not approximately reach this cost are promptly rejected, so that design time, manufacturing time, and model shop time in large amounts have been saved. For example, in order to get the switch blade for about 1/6d, none of the development work that went into the castings or into the tools could be salvaged. It was all completely wasted. Value Engineering approaches before design would have saved the time and expense.

## PRECISE FUNCTION EVALUATIONS GET BETTER "USE" AND "ASTHETIC" COSTS

Again I can't over-emphasize the validity, the importance and the benefits from intense thinking and alignment of function. Studying, naming, evaluating, writing down functions and sub-functions, regrouping and re-evaluating, etc., promote better answers.

Perhaps an example involving "use" functions and "asthetic" or "esteem" functions will assist us. Often we find that engineers who are basically performance or "use" oriented consider that much cost is in the product because of the esteem functions. One said, "I don't need all that gingerbread. I can make it work just fine, and instead of £ 3 cost, it will cost £ 1." The sales engineer who had the task of satisfying the customer's wish for appearance and other asthetic values said, "I don't have much cost in that item for asthetic purposes--perhaps £ 1. £ 2 are required for the engineer to accomplish the performance the customer wants."

It was very interesting to get the two people together and to base the discussion on the values each had assigned to the functions he wanted. Different decisions resulted. £ 1 £0/ cost was removed. A better product resulted because the important factors were better thought out.

Now let's take the case of a knob on the television set. I had the experience of speaking to a group of engineers and manufacturing and marketing people. I noticed that I had touched a sore spot. So I said: "Tell me; what is the problem?" One said, "I'll tell you. Just three weeks ago we approved a change in our TV set. We have had a switch that you pull out to turn on and push in to turn off. But these men here just changed it to a switch that is push, push...push it to turn it on, push it again to turn it off. This means added mechanism to the switch and it costs £ 10,000 a year more." He said: "I tell them it's a waste of money."

This is a true situation, illustrating how decisions are made. So I said, "Who made that decision?" Two men held up their hands. "Who are you?" I asked. One said, "I'm the engineer in charge of this." And the other said, "I'm the marketing man in charge of getting what the customer wants." We reviewed--the right people had made the decision. I asked the engineer and the marketing man, "What criteria did you use when you made the decision?" They said, "We talked it over from all angles, we thought it was a little better." Could they have more assuredly made the "right" decision?

What thinking would be produced by the Value Engineering approach? There are only two reasons for spending the £ 10,000:

one to make a better product (to produce better performance); the other to please the customer and cause him to buy this TV set instead of that one. What do we know for sure? We know we are spending £ 10,000. What else do we know? Does it work better? No! They all agreed that there was no quality improvement. There's only one reason for spending money left--for the purpose of increasing sales. Does it do that? The marketing man said, "I don't know but I'm sure going to find out if it does, in fact, cause customers to buy." About two months later I had a phone call from him. He set up a controlled test in a few places where customers came. He said, "Larry, the switch didn't sell a set in the whole test. It's out now."

#### IF MONEY IS SPENT--VALUE ANALYSIS TECHNIQUES APPLY

I'd like to bring into clear view that while we're talking about products, Value Analysis is a method of dealing with the realities of people in the decision-making situations, which determine costs. It doesn't matter where the cost is incurred through a product to a function, or whether money is spent through a service to a function, through an organization to a function, through a communication to a function, or whatever. For every expenditure there is some needed function and that function can be studied, can be torn apart, can be evaluated. Sub-parts of it can be evaluated and put back together with the same type and magnitude of results as are illustrated in the hardware.

For example, when some of the department heads of one American city took a course in Value Engineering, one evaluated the collection of taxes, another the maintenance of fire hydrants, etc. The basic functions of the tax collecting office were defined as: (1) collect the money; (2) give a receipt. These functions were evaluated by comparison to the cost of performing them reliably on efficient new machines. They could be provided at a small fraction of the actual collection expense. The cost of the modern equipment could be paid out of savings in much less than a year.

But, as the traditions of the manufacturer prolong unnecessary cost in a product, so do other traditions prolong it in a service. The law states that "Each receipt must come from a permanently bound book," hence rooms full of people writing longhand. Furthermore, since taxes were collected four times each year instead of one, this slow, tedious receipt-writing expense was multiplied by four. Why? Study showed: "In 1932, the city, short of money in the depression, got the law changed so that they could get some money sooner." Thirty years later, the practice, at four times the cost, persists. Change the law! Allow these people to serve their fellowmen better by making something people want, need, use, or enjoy instead of hourly making needless marks.

These examples clearly illustrate the effectiveness of "tradition" in continuing unnecessary cost and the effectiveness of the Value Analysis approach in identifying it in non-hardware type of expenses.

## VALUE ANALYSIS

Now for some definitions. Value Analysis is an arrangement of techniques--not necessarily new, not necessarily old, not necessarily modified; some of each, which do three things.

First, makes crystal clear each function a customer wants from a product or service or organization. Second, establishes the appropriate cost for each individual function and for each group of functions by comparison. Comparison is never to the past. The comparison used in the switch blade was not to the past costs and practices but to copper wire. Then, third, causes the necessary knowledge, creativity and initiative to be used to accomplish each function for that cost.

The Value Analysis system identifies where work needs to be done--sometimes it's in marketing, sometimes it's in engineering, sometimes it's in manufacturing; sometimes in purchasing; sometimes elsewhere; then the people whose work it is, who make the decisions, study it, re-think it through on a "function" basis and "correct the cost situation."

Value Engineering is the process of applying Value Analysis techniques in the engineering sphere of responsibility.

Purchasing Value Analysis is the process of applying Value Analysis techniques in the sphere of materials procurement.

A Value Analyst is one who has learned the techniques of Value Analysis, has developed skill in using them and is currently engaged in the occupation of applying them.

A Value Engineer is one who, by training, is professionally entitled to use the engineering title, who has learned the techniques of Value Analysis, has developed skill in using them, and is currently engaged in the occupation of applying them.

Learning to effectively evaluate functions by comparison requires several days of instruction. It can be taught like any other skill, but it doesn't "just come naturally." After a few months of use, good men become skilled enough in evaluating functions so they can evaluate a wide range of them quite effectively.

## IN MILITARY WORK--MUCH MORE PER \$

Now for a few comments about the military. In our country about ten years ago Admiral Leggett, Chief of the Bureau of Ships, became concerned with increasing complexity and increasing costs. He feared that we would not be able to get enough money to provide an adequate defense. He became so concerned that he did something about it. He assigned Admiral Dolan to go from industry to industry in search of an approach that would help to stem this tide. We are honored that he selected Value Analysis as the best of all approaches. We, at his arrangement, went to Washington and helped him tell top-level people about it. They had to know it in depth in order to use it. We then helped them conduct two training courses. Since that time we have gone through the various cycles normal to democracy in military and in government. As the anchor chain tightened, stopping the traditional drift, the people who were accustomed to making decisions in traditional ways were very unhappy. Little by little, however, it has become the way of life. Now the Department of Defense has decided that since this does get probably twice the weapons for the same cost, and since these weapons may be needed, they can no longer stay idly on the side-line, causing only the technologies that produce better performance to be used. They must also cause the technology that produces lower cost with good performance to be used.

This was the difficult task which they faced. Now they have arrived at several fairly experienced conclusions. Number one:

The way to get anything used in a free world system is to make it good business to use it. If they need more performance from a motor, make it good business and good talent will be invested and someone will do it. If they need better grade metallurgy to get more performance per pound, make it good business, then people will be trained and staffed and will accomplish it.

## VALUE ENGINEERING INCENTIVE CONTRACTS HELP

A few years ago they started experimenting with incentive Value Engineering clauses in contracts. They let some contracts. They have accumulated some experience. Now they are essentially making it mandatory. The contracts, of course, are probably quite like yours. They vary in form, but let's take the case of a fixed price contract where a considerable definition of the specification is possible. The approach was to cause the contractor to hire and train professional Value Engineering people so that a different discipline would be used. The results then are normally divided

fifty-fifty. If, for example, on a ten million pound contract, Value Engineering identifies enough unnecessary cost to cause it to cost nine million, the government then gets procurement for nine and a half million pounds and the contractor gets an additional five hundred thousand pounds for his risk, his expenses, and for his earnings. Of course we also have contracts for research and development work--the cost-plus type of contract. A contract that now seems to be quite good in meeting a variety of problems where designs are not too well known is the cost-plus-incentive-fee contract. Our large military contracts many times have this incentive fee divided into three parts. The contractor gets less fee if he doesn't reach a certain degree of accomplishment; he gets more if he exceeds it. The three are: (1) performance of the equipment; (2) delivery of the equipment; and (3) cost of the equipment. In addition to that--now comes the Value Engineering technology. On one large contract in my experience, the contractor was told: Staff and train yourselves in Value Engineering and we will provide a 40/60 additional incentive on savings. Since you already benefit some by reduced costs in the cost incentive of your main contract, it will not be 50/50, but rather 40/60, the government keeps 60%, pays the contractor 40%.

#### VALUE ENGINEERING IS A GOLD MINE IN RESEARCH AND DEVELOPMENT

We generally accept the viewpoint that research and development is comparatively immune to economic processes. There are many reasons for this: for a hundred years we have been expanding performance capability. If we created a new product or greatly improved a product's efficiency, it was marketable. Now, however, we are faced with a different situation. There are many mature products. Great steps in efficiency are not being made in refrigerators, in automobiles, in ranges, in motors. Now the functions the customer wants have been pretty well leveled off from a performance angle, and probably the company that endures will succeed by excellence in handling the economic factors while keeping all the performance factors. So in research and development even a different look is coming.

I occasionally visited a large electronics plant where management had always said, "We can't use Value Engineering much because every product is different from the last one."

Each time I was in the factory I saw racks of electronic gear, cabinets of this and that, mechanisms, filter circuits, detector circuits, you name it. I said: "You told me you never make anything alike. I think that's a fixation. I don't think you ever make anything that is different. You put a little different capacitor in it, make it a little different shape, what you have are functional units that repeat thousands of times." Surprisingly, they

took a different viewpoint. They saw that electronic gear is composed of functional building blocks. It lends itself to this Value Engineering thinking.

For another example, a skilled Value Engineer said, "Larry, I wonder if we really can use Value Engineering in the advanced state of research and development before we even have things worked out. Wouldn't it delay the procedure?" Let's look at it. Certainly in the research and development I'm talking about, we're not just trying something to see what happens--we have a purpose. We have a function or a package of functions we want to accomplish to a higher degree. I said, "Suppose that right now we evaluate these functions and that research and development people deny themselves the expediency of spending time and resources on something that's going, at best, to result in a complicated, costly solution to the problem." We then took a few examples. One was a small spacer stud from an appliance. Certain development work went into providing it. It cost 9d. After value engineering was used, it cost a little less than a tenth, and accomplished the same total purpose. If they had originally evaluated these two functions--a holding function which we compare to a screw, worth 1d, a spacing function which we compare to a piece of tubing worth 1d, total 2d, it would never have been turned over to a draftsman for a screw machine part, bound to cost from 9d to 1/. Rather, it would have been recognized that to accomplish the functions for 2d, the approach is wrong. The thinking then, instead of now, could just as well have produced the approach that makes it from wire, coining the two heads and resulting in a cost less than 2d. So, I submit, we have gained nothing from the development cost on this typical part--nothing to help later in the good low-cost solution. Several examples worked out the same way. I believe that we will see progressively in the next five years a recognition that using Value Engineering techniques and principles which cause this thinking before large resources of time and of money are spent in research and development will really pay off in good working solutions at much lower cost.

Again one asks, "How much of research and development is really new virgin soil?" How much of the electronic radar spot focuser which we discussed was really new? Less than 5%. Experience shows that ninety-five per cent of cost goes into what has already been done before. It's making a little different support, a different shape, something a little smaller, something a little different, but not new technology. Ninety-five per cent can come right under economic study and control.

#### EVALUATE MULTIPLE FUNCTIONS

Let's tie the Value Analysis techniques together by using an example which has four functions on a large motor. First an end

shield cover goes on a large motor. Let's change our thinking from parts to functions. What does it do? The motor is two feet in diameter and contains four of these pie-shaped covers on the end. It

- |                         |                      |
|-------------------------|----------------------|
| (1) excludes substance  | "use" function       |
| (2) allows ventilation  | " "                  |
| (3) allows ready access | " "                  |
| (4) pleases customer    | "aesthetic" function |

Now we're through the first step--we know precisely what the customer wants.

Second, what is the appropriate cost for each function?

- (1) If we were only excluding substance, we might use a flat piece of sheet metal. It would cost about 1/. (2) Now let's take the next one--to allow ventilation. Add some cost for perforated instead of solid steel or for a hole-punching operation or other. A shilling was added. (3) Now for the function of allowing ready access, comparison was made to a simple and effective screw-driver-opened latch. Another shilling was added. (4) Finally for the "esteem" function: It must be painted appropriately in color and texture. 6d were added. Since these functions were evaluated in appropriate sequence using the previous solutions as a base, it is valid to add--for a total of 3/6d. But what does it in fact cost, having been designed and manufactured without this system of thinking? £ 2/3!

These new criteria caused thinking and actions which changed the cost from £ 2/3 to /9. Four shillings of the nine were to continue a large knob on the opening device. It was for "esteem" function. "The customer has learned to like the large knob." The marketing man said, "The customer looks at this knob and confuses it with quality. If we take it off he will feel that we are cheapening quality and that we've lowered quality inside the motor as well." Of course, quality was not lower, but what the customer believes is very important. He said, "Leave on the knob." He further said, "We'll talk to the customers during the next two years and point out this knob as a separate item. We'll ask them if they feel we should still include this extra cost in their motors." Probably we can later eliminate some of this cost, which most of us would say serves little purpose for the customer, as we can have him understand what is being done.

#### VALUE ENGINEERING STARTED FROM "NEED"

How did the Value Engineering system start?

In the late 1940's, General Electric Vice Presidents of Purchasing, Manufacturing, and Engineering so often saw how, although we had tried so hard and thought we had done so well, the same functions could be better accomplished for much less cost. I was fortunate enough to have had design engineering, manufacturing, and purchasing experience. They asked me if I would like to conduct some research on it. With several engineers and purchasing

people, we examined successful competitive products to determine:

1. How much extra cost still exists.
2. The cause of it.
3. What was necessary to prevent it initially, or remove it much more promptly.

We found that competitive products contained about half unnecessary cost which could be identified by this new approach. Military products contained about two-thirds unnecessary cost. This was very shocking and startling. Then we put together this set of techniques so more and more people could use them effectively. When, after two years of research and development, the techniques could be demonstrated and results proven, the vice presidents said, "Train 1000 men a year." From that beginning the program further expanded.

#### MAKE "GETTING VALUE" A MEASURABLE SCIENCE

Research further made clear that in addition to proper delivery, there are only two requirements in a good product or service: (1) appropriate performance from the customer's viewpoint; (2) appropriate costs from the producer's viewpoint. Generally speaking, engineering people have reduced to a fine science the predicting and measurement of performance. They know whether the motor puts out 100 hp or 100.1. They know the temperature rise, the vibration, the losses. The other half of the task of getting value... i.e., having appropriate cost... is artful. It is our purpose--and we are well on the way--to make the task of getting appropriate cost and its steps just as measurable as the task of getting appropriate performance.

#### THE "RIGHT" SYSTEM OF THINKING GETS "SIMPLE" "EFFECTIVE" RESULTS

One major problem was that people, looking at any one result from this system, usually said, "It's simple; there's nothing to that. Any good designer would know that you should make this from wire instead of from bar and cut the thread. Later when Value Analysis became popular and top management said, "Do it!" what happened was that in some areas industrial and manufacturing engineers just changed the name on the door to "Value Engineers". All of a sudden they became "Value Engineers".

Changing the name is nothing--and is harmful. I have used the example of the sheepdog. One might think it good to change the family sheepdog's name. One might call it a cow, but it still would be a grand error to then expect it to produce the family's milk. This "name only" Value Engineering is something to contend with and to minimize by understanding and training.

## CONCLUSION

What I'm saying is that this is something to help all decision makers have better criteria more promptly in dealing with economic factors, criteria which will help them to keep their performance factors but get better economic factors.

Those of us in this work feel that we have here a tool, a discipline, which will produce much more goods or services for the same amount of resources.

Q. What are the basic principles of Value Engineering?

A. "First of all, understand precisely what the function is. Next, break it down into its sub-functions; then, without allowing the thinking to be influenced by the past, creatively establish alternative means for accomplishing each small sub-function in its simplest form. Assign sterling value to the function. Cause the required actions to secure it for that cost."

Q. I am concerned with research. I'm not concerned with mass production. I want to ask you about organization. Are you suggesting that Value Engineering is a thought process, a habit of mind, that the design engineers themselves should acquire, or do you see it in my type of work as an additional function to be performed by people called value engineers?

A. "Value Engineering contains a discipline which must be learned and can be taught and which is not completely or effectively included in the other good disciplines that have somewhat different objectives. I would answer quite directly by comparing with a metallurgist. When we found we needed more push per pound from the jet engine, we knew we needed more specialization in that one area, so we brought it in to the extent needed. Metallurgists study the situation and advise the decision-making engineers. Likewise, when it becomes important to get much better economic objectives in the research field, you will then want to staff yourself with the correct number of highly competent people who have this specialization. They will work for and with your people who are doing the development and thereby, in my judgment, shorten the research and development process and very much reduce the end cost."

Q. Who would know when to call in value engineers?

- A. "There will be no Value Engineering in any organization unless costs are important. We put together in this system, techniques that have only one objective: identifying unnecessarily costly approaches, promptly and efficiently. If cost is not a major factor, don't bother with it. If cost is important, it has the answer. However, the engineer must know that his boss will give him credit for calling in the metallurgist he needs, calling in the stress analyst he needs, calling in the advanced mathematician, calling in the value engineer, or whatever specialist is important to accomplish the top objectives of the business. Only when value engineers are invited to the problem, as when other specialists are invited to the problem, can they contribute. You don't have a metallurgist going around, talking to engineers saying, "What can I work on?" Don't do it that way with Value Engineering either."

L. D. Miles  
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