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a definite place in the development train of events. I am not sure I have found the right place for value analysis, but I think I am moving in the right direction.

If I go to my boss and say, "Value engineers should get a pay raise," I make the same equation I use to hire a PhD. I say training, education, and background require that I should do this. If I say this man can do all this in the performing of production, and I say besides that he is good at systems and procedures, I have ruined the thing. I no longer have a precise, scientific job. I have a catch-all, and I think it is going to kill it at this stage of the game.

CHAIRMAN LESLIE: What we would like is to have the systems and procedures people utilize certain fundamentals out of the value analysis "package" so that they will identify certain areas of responsibility, just as we ask a design engineer to utilize these areas while he is developing a product.

OLSON: I think that is a good point. If we can develop a few simple tools that they can use to

do the same job, and give the tools to them, I will be happy.

LEONARD: Value engineering is a new thing and I am aware of the starting of the Chicago Chapter (of SAVE). I recommend that anybody who thinks of "going beyond," take a look at some of the other societies which started years and years ago and never established any degree of professionalism. The one I have in mind is the Society of Reproduction Engineers. They cover the gamut and they have no status. If the organization is going to establish real status for itself, or the people in it are going to establish real status for themselves and define for top management people their professional status, they had better be careful.

MILES: I am inclined to agree. I wonder if the word "organization" should be stricken out of the definition. This is not the time to debate it. I agree we want to keep it precise, concise, definitive, and restrictive. I know these techniques apply to other areas, and perhaps for the present the word "organization" should be taken out of the definition. Give me some recommendations, will you?

## What Lies Ahead in Value Engineering



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As we look into value analysis and engineering, I know you know that I believe and feel everything I am going to say tonight. I feel pleased and fortunate to be living at this time because I believe that this dynamic movement is just starting and will never stop. It is a movement that is so timely. Some sage made the statement, "No power on earth can stop a movement whose time has come." I have seen many things that indicate to me that the time has come, and value analysis is moving forward for that reason.

I would like first to discuss what I call a deeper understanding of what we have in value analysis techniques.

Sometimes I wonder why we have so much trouble communicating value analysis. From 1955 to 1960 we had outstanding techniques; but we received derision, opposition, and belittling. You all know the reason for a lot of it, but maybe one reason was that we ourselves didn't understand quite as much as we now do. Therefore, I will discuss some of the things I believe are significant.

### Appropriate Performance

First, the term "value analysis" sounds weird to some people. What, I wonder, does it mean to them. I receive good insight by asking questions. They say that if a product has appro-

priate performance and appropriate cost, they believe it has value. I do too.

Then value analysis must of necessity be something that deals in both performance and cost, and it is. Our engineering vice president (of GE), Harry Winne, who named it Value Analysis, said, "You consider both." You take the performance the engineers have specified and decided is needed, you hold that static, then you work on cost—so you are really not doing cost work, you are doing value work. You are considering both, although you are working only on cost.

What is appropriate performance? You are far too sophisticated to say, "to have the product 100% efficient," or "have it work as well as it possibly could." This is the definition learned in college. Appropriate performance is probably performance as good as, or probably a little better than, competition.

#### Appropriate Cost

What is appropriate cost? Again, it is probably cost as low as, or a little lower than, competition. We don't have a hard job; we don't have to do the ultimate. All we have to do is as well as, or a little better than, competition in both areas.

We have been perplexed and plagued by widespread misunderstanding that any activity which has cost reduction or prevention as its objective is appropriately called value engineering, or value analysis. This of course is untrue.

To get appropriate performance there are well-known and well-established techniques that have done an excellent job throughout the decades.

To get the other part of value—appropriate cost—we have traditionally had a number of excellent techniques, and they are not value analysis. They include certain design practices that result in lower costs, production engineering, industrial engineering, work simplification, good buying, and a number of other techniques necessary to get lower costs—but they are not value engineering.

#### Identifying the Problem

What, then, is value engineering? Incidentally, I use the terms "value analysis" and "value engineering" synonymously until the part in my talk when I will read the definitions we have prepared. After that I will use them specifically.

Value engineering is a specific set of techniques that are unlike the others I named. The first group is knowledge techniques. Someone knows a lot about materials, for example. The value engineering techniques are different. Their operation is to show where more work from the knowledge techniques is needed on the product, and to cause that to be done on the product.

Learning more about tooling is not a part of what a value engineer learns. Learning more about plastics is not a part of his training. But learning how to identify the problem, to find out where the deficiency of work is, and to get someone on the job who will apply that knowledge is the role of value engineering.

#### Value Applied in Stages

Where is it applied? Value can be lost in any one of seven stages in the life of a product's development. The stages are all done in series on a product, and there is no measurement on any one to tell the efficiency of applying technology to get appropriate cost. What are they?

First is the stage of "marketing concept." If the marketing concept of what the customer wants is wrong, we are definitely started on a path that will wind up with a product that will cost the customer more, or do his job less efficiently. We must have certain minimum work done in the marketing concept stage, or the case for value is definitely prejudiced.

Next is the design concept stage. Shall we do it with electronic circuits or with selsyns? Shall we take one whole design approach or another?

Next, as we move along, is design detail. We can certainly lose value as the hardware is drawn, and the selection of material, tolerances, and of shapes takes place.

Next is the manufacturing concept stage. We can lose appropriate cost there if we have too much automation (or too little), the wrong type of factory, the wrong type of organization, or if we buy too much or too little. There are innumerable ways to lose it there.

Next is the manufacturing operation stage; we can lose it without half trying in that stage.

Next is purchasing. If we do not have good buying, good search, good negotiation, we can lose the profit.

And finally, and you can put it either before or after, is the management practices stage. Management can have certain practices, such as policies and habits, that add extra cost to the product.

The only way to have appropriate cost in a product is to do as well overall as competition does. Obviously, they don't do very well either, so it is not a difficult job to have appropriate cost.

You may ask, "What would be the ultimate cost for a product that is reliable and attractive to the customer?" In that case we would be working against the ultimate instead of against competition, and we would find that we could produce the product for a third to two thirds of the cost of what is a good job today.

## Spotting Deficiencies

The function of value analysis techniques is to point out if the deficiency is in management practices, marketing concepts, design concepts, design detailing, tooling planning, factory operation, or in purchasing. They should cause the people in those areas to act.

Often we hear, "We want the right design first." There is no such thing as black and white in having the right design. Either you have a design that meets the best of competition today and gives you good profit, performance, and reliability, or it doesn't.

We might well recall that any product of any size is the creation of thousands of decisions. A relay, for example, involves a decision to use silver and to use brass backing, and to use certain shapes and certain amounts of sliding contact, and certain pressures, and on and on and on. If the product is of any size, there are at least 100,000 decisions that have gone into it. These decisions control its cost and its performance.

What kind of cost would you expect it to have compared with what would happen if you updated, by some brilliance that is never attainable, every one of those decisions? This, the objective look, is what value engineering tends to do.

## Grounds for Understanding

At the end of a frustrating session a German doctor, an atomic scientist, gave me insight. He said, "You have the same problem we have in the atomic field. It used to bother us, now it doesn't. When we undertook to explain to management and others, who had to make decisions that affect our work, many of the things they needed to know, we found that we made no impression. They just didn't understand it.

"Then we saw what was happening. We were talking to them above their level of general understanding. To raise a person's understanding you teach differently than you teach technique.

"We changed our approach, and we decided that they had to have the general level of understanding in the atomic field raised, and then experience would be meaningful when we related it to them. We changed, and it worked like magic."

I recognized that as one of our most important problems. Even today, people who have not had experience in value analysis techniques do not see how they fit, do not understand enough about it so the experience is meaningful. I suggest that you consider the environment you are attempting to instruct in and decide whether the people you are talking to really have a basic enough understanding about the nature of unnecessary cost to interpret what you are saying. It is normal for people to discredit what they do not understand.

## Learn to Live with Conflict

I grew up in Nebraska, and I have wonderful parents. My mother was especially a loving person. I somehow got the idea that conflict is bad, that there should not be any in the world, in a family, or in a company. Love is the way of life, and conflict is the deviation. But when I read the book Conflict, I recognized how naive is that viewpoint. Conflict is the way of life, and those of us who were educated to believe it is wrong are handicapped.

Conflict exists everywhere. Why not treat it as a friend, because it will be here whether we want it or not. Any thought of "I wish there weren't conflict" is ridiculous. There is conflict between nations, people in politics, government and industry, husband and wife, parents and children. Any thought, any planning should take into account the fact that there will be conflict. Techniques should be developed for dealing with conflict, which we always have in work which involves change, and it should be treated as an expected friend.

## Some Significant Definitions

Let's turn now to definitions:

- Value analysis: an arrangement of techniques which makes clear the functions the user wants from a product, service, or organization; establishes the appropriate cost for each function by comparison; then causes the required knowledge, creativity, and initiative to be used to provide each function for that cost.

- Value engineering: the process of applying value analysis techniques in the engineering sphere of responsibility.

- Purchasing value analysis: the process of applying value analysis techniques in the sphere of materials procurement.

- Value analyst and value specialist: 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.

- Value engineer and value consultant: 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 applying them.

- Purchasing value analyst: one who has learned the techniques of value analysis, has developed skill in using them, and is currently applying them in the sphere of materials procurement.

I am sure that you will have ideas which will help us to improve these definitions. I believe they are close to being restrictive, definitive, and effective in their present form.

## Measuring Value Analysis

How do we measure value analysis? Let's compare. We never use specialists or consultants until something becomes especially important. When taxes were low, everyone in accounting in that particular area learned tax accounting. That was good enough. But with higher tax rates, it became especially important to do a better job. The most costly approach would be to teach everyone all about it. The efficient way is to have one man whose knowledge penetrates to great depths and use him at the right time—and he is a consultant.

In developing products such as radios, toasters, and motors, the ordinary engineer knows enough about metals so he doesn't need a high-temperature metallurgist. But on a product such as jet engines, the most costly way to operate, both from performance and cost, would be to try to make an extremely knowledgeable high-temperature metallurgist of every engineer. Therefore, consultants are used who penetrate that knowledge at the right time.

How are they measured? How do they get on the job?

You measure him by his help to the business, by the degree to which the business achieves the objectives which are his specialty.

How does he get into the job? How does a metallurgist get into the job? Probably the president of the company says, "I expect that engine to put out a certain amount of thrust per pound and the only way to do it is to do a top-grade job in getting to higher temperatures." The knowledge and techniques of the higher temperature metallurgies are called in. As soon as the president says the same—and means it—in the area of costs, there will be no problem in getting the man who is trained and qualified in cost called on the job.

## Evaluating the Function

What is "value analysis" in the terms we are talking about? It is a group of search-oriented techniques, as contrasted with the knowledge-oriented ones, which are in these other technologies, which come in to help solve a problem. It has the new element of evaluating the function. This does several things, one of which is to make the lower cost credible. No man will work hard to accomplish something that he believes impossible. Once he has evaluated a function for \$100 and something is costing \$1500, it is credible to him. He also knows who to call in to get the answer, and now he will do it.

The next technique that value engineering technology has that is shocking, and is not believed by even 1% of the people today, is that as soon as it becomes important to reach challenging economic specifications as well as challenging performance specifications, we totally reverse the approach.

Instead of first designing to performance and spending our time and money trying to make it work, our first objective should be cost. We will think so much harder at the start that we will not burn up the company's resources of time and money developing the first approach to work only then to find we can't afford to make it. Therefore, because we face the problem of cost first, the first time we get an answer that performs reliably we have both answers. We have performance, and we have cost. This is the approach that is forced by evaluating the function and by some other value techniques.

I took at least a dozen examples, studied them, and was shocked to find that when we first go after performance and then decide we have to get cost, we usually have to throw away most of the experience, time, and money that we spent in first getting performance. The reason? We chose the wrong design concept at the beginning, and we can't even hope to get it in the right sphere of costs. If we backtrack, it means all our tests and our work and most of our experience is valueless. Usually we have neither time nor money to backtrack. The costly product must go to market and doesn't leave any profit in the till.

Another part of the technique is the "quick rejection." If an idea doesn't come within the framework of proper costs as we first look at it, it is rejected and we use other search techniques to get another and another and another until we get a right one.

## Recognizing Roadblocks

Here is another technique that is quite unusual. We like to say we are all smart people, we are all one fine family, and if we can show Joe a better way of tooling and save the company money and get good products, he will do it. This is totally false. People are not logical, they are psychological. We deal with reality when we recognize this. We will know that roadblocks exist everywhere, and the roadblocks are people. It is what people believe, or their habits, or the screens they look through in different situations. Many value analysis techniques are for the purpose of getting a clear view of the roadblocks, and then dealing with them.

Let's look at some ideas that have helped. Some of them seem simple, but it took a while before a smart man brought them forth. One common fallacy is that selling prices are established on costs. For example, before bidding on an order, the sales people will phone the factory and say, "What are the costs? I need to quote a certain figure. Are your costs low enough so I can do it?"

The customer doesn't care in the slightest how much it cost to make chips. This is totally irrelevant information. Furthermore, if it is done this way, it will make the business sick. There will be plenty of room in the factory but that will

cause the costs to be high, and thus the company will lose more orders and have even less volume. Everybody blames sales, sales blames engineering for poor design, and all of them blame manufacturing for too high a cost, and the business heads down the drain.

The simple way to face it is to deal with the realities of a business situation. Sales are made at market levels. If one fellow is selling tomatoes for \$1 a bushel, they will be \$1 a bushel all along the street. Or they may be 99 cents. But you won't find somebody offering them for 50 cents because his costs are lower and he works his kids for nothing. His will be \$1 and he will have 50 cents in his pocket to buy shoes for the kids.

Make the sales at the market level. If you can't sell them because they don't perform to suit the customers, your performance engineering needs fixing. If the product performs satisfactorily and you get orders but you don't have any profit, your costs are wrong. Fix them. If your costs are right and your performance is right but you can't get the orders at market levels, your sales system is sick. Fix it. In any case, the problem is now clear and it can be solved right where the trouble is.

We are anxious to have this system adopted because where cost is the problem, it brings it clearly into focus. It takes a courageous manager to do this because if he takes orders and his costs are too high, it will show up at the end of the year that he is operating a business that has too high a cost and is operating at a loss. However, if he doesn't take orders, you can blame everybody for everything—it is the sales manager, it is the times, it is a lot of other things.

#### Beware of the "Killer" Technique

Let's look at some quick guides. Whenever anyone offers to test to extremes, recognize that this is a "killer" technique and that the product is sure to fail. No test to extremes is ever valid. For example, if I say drinking water is good, you might say, "Then let's see you drink a barrel." This is a technique to use when you want to stop someone else's project.

A man must believe in making a product a success or it will not succeed. For example, there is no product on earth that won't be a failure if the man using it wants it to be. Often a manager will say, "I know that my manufacturing manager, Tom, thinks that stuff is for the birds, but I am going to put it under him. Then while it is under him, he will see how wonderful it is and everything will be fine." But it doesn't work that way. The tests don't come out right, the devices aren't produced, and things go sour.

Suppose that I want to prove that a cup of coffee is bad. How long would it take me to do it? Is an automobile a good thing? Suppose the man at the

wheel says, "I will prove to you that this automobile is a murder weapon." How long would it take for him to prove his point? This is of primary importance in delegating work in value engineering. The battle is over and lost if you are reporting to someone who wants it to fail.

#### Decisions—All Shades of Gray

Let me note in passing that decisions are made by judging shades of gray. There isn't such a thing as black and white in a decision. If it were black and white, there was no decision to make. No man would be required, just a machine. All decisions involve picking the shade of gray that is best for the business.

These shades of gray are made up of three parts. One part is the shade that comes from the boss, from company policies, from company rules. What do people from above think you should do in this kind of a situation? Should we make the product black, should it be made smaller? What do they want?

The second shade comes from our own experience which gives us a screen through which we look at everything. For example, if you had just experienced a costly bronze bearing failure and had to overhaul 100 jet engines at \$1000 each, and someone said, "Use bronze" for something, you would cringe. Why? Because you have a screen on bronze. Our screens are extra black or extra clear depending upon our experience. I doubt that we look at anything objectively—no matter how hard we try—so we superimpose our screen. A third screen is composed of the objective facts which can be brought together at that time on that situation. The person looks through the three screens and his decision is this or that. The decision could just as well be made by a photocell if you could set up the screens.

#### Adaptable in R and D

I have been startled when I hear people talk about research and development work as though it were new. Recently I was in an electronic plant that never makes two products for the military with exactly the same output, and the engineering manager said, "We are perplexed that every product, every order is different." I had been in his plant four times in five years, and every time I saw the same racks of electronic gear and piles of transformers, brackets, supports, cabinets, and tubes.

I said, "I don't think you ever make anything that is different. It all looks the same to me!" We talked about it and soon the manager changed his opinion 180 degrees.

He said, "Actually, we use tubes, filter circuits, and amplifiers. We always make the same thing with a few minor variations."

The idea that value engineering doesn't work well in research and development because each item is different is invalid. This is a situation where the only thing that holds up progress is this wrong idea.

We often hear, "We only make one at a time." It may be a boiler, a turbine, or a guidance system. Is that true? The same thing—exactly? "No, not quite. It is always a little different."

Guidance systems, for example, have a million terminals in them, a hundred thousand of this, ten thousand of that. It is full of repetitive items. It has repetitive circuits all the way through. On these so-called "one-of-a-kind" devices, my experience is that nine-tenths of it is heavily repetitive. The technology will work just as well if we can get away from the idea that it is one, and recognize that it is a composite of large quantities of items.

#### Accepting Planned Obsolescence

In conclusion, let me state four thoughts. One is the very revolting but very proper idea that in a healthy business engineers should definitely plan to obsolete their own products. In this day of exploding technology any product is going to be obsoleted, and it will be done either by the engineer or by the competition.

Engineers work hard, make decisions and tests, and finally get something that works. It becomes part of them. Under these conditions, they don't want to obsolete their products. But if they don't, competition will. And at the same time competition will take a bite out of their business.

Perhaps you could be of service to your company if you could convince your engineers to see the high virtue in they themselves setting schedules in which they obsolete their own product—and become proud of it! They should do it soon enough so that the marketing staff won't have to go all-out to recover lost markets.

#### Developing Relationships

As we look into the future, we will see more and more value analysis techniques. They will be in the field of measurement because value analysis is function-based. We will see function-cost relationships developed, available, and used. We will have function-cost relationships just as we now have materials-cost relationships in a catalog, or functions materials in a handbook, or properties materials in a handbook.

#### Cost Planning and Actions

In the future we will see appropriate cost planning and appropriate cost action. Brains and technology will go into deciding what is needed in costs in the time ahead, and what actions are needed

now to get them. This is especially true now that we have value analysis techniques which will accomplish the hard job of getting the costs needed.

Before I state the final conclusion, I want to make clear that we all recognize that in the military area we are really doing quantity engineering. Don't expect to save money in the military area! It just doesn't happen. But we do not have enough weapons! Some of our ships go out with half-filled magazines because we don't have enough money. We are spending all our money but we don't have the weapons we need. Value engineering has the answer for that. We can have twice as many weapons in the magazines and twice as many magazines when we fully apply value engineering.

#### Assigning Cost Responsibility

My final prophecy is that, just as we now have someone who is responsible for performance, and someone who is responsible for shipments, someone who is responsible for sales, and someone who is responsible for keeping the records correctly and legally, the manager will have someone responsible for appropriate costs. Costs no longer will be considered "everybody's business."

We see more general managers and company presidents losing their jobs because of inadequate costs than anything else. Why? Because they have no one to whom to assign the "cost" job. If the problem is performance, they call in their manager of engineering and say, "Fix it," and he either fixes it or they get someone who can. The same is true with sales, manufacturing, shipping, but not with costs. That is the president's job or the general manager's job, but it has not yet been recognized as such. You will, within the next few years, see that this is an important job, and it will be handled in such a manner.

#### Discussion

LESLIE: A problem concerning all of us regards the cost of the product (appropriate cost) and appropriate performance. These are two important features, but there is another item that arises many times, especially in the military. That is, "appropriate delivery." I have heard many times the statement, "We just don't have time to do it."

MILES: Normally, we approach a job backwards. In 99% of the cases, even in the military area, we know how to do at least 98% of what needs to be done on each new order. We go ahead without hard economic standards and we use up the time we have before we get the first breadboard model that works. Then we do have a time problem, so we have to ship the complicated, unreliable, so-called breadboard models.

The minute we face the fact that most research and development is repetitious, and that we can put

the quantity job ahead of the performance job on military hardware, we will not chew up that time, we will be working on the solution that will be more reliable and lower cost all of the time. I told the head of Army Research and Development, Washington, that when value analysis techniques are fully

used, one third of the time will be cut off the development period, and the resulting weapons will be two-for-one. They will be more reliable because they will be based upon better, simpler answers for accomplishing functions.

