

Thank you Dusty. Good morning folks at Boeing. It is a real treat to be here and without seeming trite I would like to tell you that some of your information on methods of securing appropriate costs have been in our office for a half a decade and we honor and respect your leadership in the way you went about it. As I would like you to consider me as a source of answer to any pertinent question you would like to ask as your consultant on matters you might be a little concerned about, I am going to give you the chance to ask those questions. Ask any kind of a question and if there is experience on it, I may have come in contact with it.

I would like to congratulate you men on the fact that your management here understands enough about Value Engineering so it is behind it. I've had enough association with Charlie Brewster so that I know this is the case and I assure you when this type of technology first developed a few years ago it was so new that the earlier companies trying to do a good job such as you are doing had a much more difficult time to communicate its benefits to management. I would like to make one comment for the benefit of our management members here before I get along with my program. You have seen results shown by these men who have learned a different set of techniques. You didn't see the technique. For example: you saw the healthy man, you didn't see the food he ate to make him healthy. The techniques of Value Engineering are a specific set and program of techniques which cause problems to come into such focus that simple and practical solutions which you see here come forth. And one final thought, do you realize that it has only been half days for two weeks that these men have been working on these things that they have shown you and that they had to start learning this special technique system at the start of those two weeks. I am just delighted at what I have seen and I think you will feel the same

Now, I have a pencil here and I would like to talk exactly to your interests sometime during the program. I'm going to list any questions that you would like to ask - things you would like to have me discuss. I have planned things I want to talk to you about but I will include anything you would like to hear about. What would you like to have me answer or deal with? and feel quite free to bring up any type of a matter. What is some question of some concern? "What phase of motivation? How?" Good. "How to motivate the design and the other equivalent people sufficiently to meet the other forces and get this done too?" Another question. Speak real loudly will you? "How to implement at start of program? How To get these changes into the program?" (Three of four questions were asked which I could not hear and Mr. Miles did not repeat.)

Now to get a common language let's start with what value probably means to us. Value means to most all of us something that has appropriate performance and has appropriate cost. If it lacks either, it doesn't have value. Now, in the appropriate performance approach we have appropriate quality. We have appropriate reliability. They are part of the performance part. In addition to that, we must have appropriate cost. Now for a minute let's say, well, what do we mean by appropriate performance? I think what we mean by it is performance equal to or a little better than our competitors. Now in a case of missiles our competitor is Russia. But, I'm making statements that not only will apply here but to your airplanes and commercial products too. Appropriate performance in general is that equal to or a little better than the competitor. What do we mean by appropriate cost? Well, the same thing. Appropriate cost means cost equal to or a little better than competition. Now in the military, the appropriate cost has a little different angle because

don't use the word cost, we use quantity. We have to have two things to have value in the military here. We have to have appropriate performance and appropriate quantity and I interpret this whole meeting as being a part of a program to assure the U. S. of appropriate quantity. This is one reason I was so happy to be invited to come out and help in it. Now, with two things to get in order to have value in our products the performance part is under pretty good control. You people have fine technologies for determining efficiencies and for measuring and for weighing and for testing. I know you have your problems but you have a good technology for it. The other part of the value equation, the appropriate cost is in an exact opposite condition. We do not have good measurements. Appropriate cost is an art. Each man gets his performance and does as well as he can with the tools given him by management, with the time given him with the help given him, with the knowledge he is able to have or get or solicit by the time he has to make his decision. Therefore, the technology of Value Engineering is a technology to start to organize and make the job of getting appropriate costs just as predictable as the job of getting appropriate performance. Now we go after appropriate costs normally by a group of technologies which are not Value Engineering. One is certain design practices, another - production engineering, industrial engineering, work simplification and good buying methods. All of these things are good and are necessary and are being done, but let's be very careful not just to rename these good knowledge technologies "Value Engineering" because putting a different name on something does not get any better results.

In addition to those things, there is another technology which we call Value Engineering and that's what the men have been learning here. It has no depth

knowledge in specific design engineering techniques, in plastics, in any material. What does it have? We are talking about a system of techniques in Value Engineering for identifying a problem thoroughly and properly and in a somewhat different way and using a system of search techniques to bring to that problem the technology that is needed to get the answers. I could see it running through all of these examples. The men would first identify just the function that has to be accomplished. This is the first step in the value technology. Identify it clearly, sharply, cleaner than we normally do. Next, how do we get that function? Sometimes you solve them, bring in the technology of casting, sometimes of fabrication, sometimes of buying, sometimes something else. So I want to set up very clearly before you we are not in teaching Value Engineering techniques teaching anything about these manufacturing engineering processes or other technologies. We are teaching how to recognize a problem, how to get it into solvable terms, how to search and get the help we need and get it and in time for the decision making. It means understanding the problem and getting it and in this kind of terms. Now again just to clarify, all of us who were in design engineering always did think of function and we always did use some of these Value Analysis techniques. And so we have a tendency to think well we always did the type of thing we see here:

I want to exaggerate about 2 or 3 percent once in a while this morning just to make points good and clear and rest assured they are 98 percent true or I wouldn't say it. The first one I want to read off the list is, I want to say that this technology is new. Value Engineering is brand new. It did not exist 15 years ago. Actually the names were coined by our Engineering Vice President when he saw that it kept performance and got cost and he said both performance and cost give value. How

do I say that? The new product is not something exotic, something totally new, but any new product or process or technology put together from known technologies or products certain usable parts in a different arrangement, and adds something new and provides a new product. For example, the airplanes have much in common with the automobile. If we use the same simple comparison, the automobile has wheels, engines, fabric, motors, steering wheel, you name it; same as the airplane. But is the airplane a different product? It certainly is. Because it arranges them differently, uses them differently, adds a few things that are new, emphasizes others and accomplishes a specific result. Therefore, from Value Engineering results I want to urge you to expect unnecessary cost to be identified with not more than one-tenth of the cost, not more than one-tenth of the time that is required by doing so by prior methods. This is the sole purpose that this kit of tools was put together. Just a word on what the heart of the Value Engineering system is for the benefit of a few of our guests who haven't had the experience that most of you have.

The heart of Value Engineering is going way overboard on function. Recognizing that the only reason the customer buys anything is because it accomplishes a function, there should be no cent of cost in it that doesn't contribute to that function. The functions are in two parts: The parts that cause the product to work and the parts that cause the customer to select this product and buy it. We call it use and esteem. There are lots of other costs in the products which are found by these men, as you see, when they study today the functions, exactly what the customer wants and how much cost is necessary to get it. This is the cost that then comes up for removing.

We have found that unless the thing is credible this will not be believed and I

is so much unnecessary cost in everything. First, let me just make the statement that everything is filled with unnecessary cost. Consumer products normally we consider 25 to 40 percent of the cost makes no contribution to performance, safety, efficiency, maintainability, reliability, customer features or appearances. In the military type of product it runs about 75 percent on the basis of experience and I am sure we are seeing that as we see the little parts of the problem the men had a chance in two weeks, half days, to come to grips with and how much better answers they could find for increasing the quantities at no increase in cost to the government. Now, the first thing done is we need to get a sophistication in our company's management at all levels about unnecessary cost and the realization that they are full of unnecessary cost and it's nobody's fault; it's just a way of life. Man should never be criticized for having unnecessary cost. Now a company will have a problem if it has too much and the technology is to help efficiently and reduce the unnecessary cost. "Where does this unnecessary cost come in?"

In a product development cycle there are, as I remember, about seven places where it comes. It starts coming in heavily in the marketing concept stage. A marketing concept something sold to the customer with certain concepts can lock up costs that will never come out. Next we come to what we might call the product concept stage, which is very close to that. The customer wants to buy certain functions. The first things those functions do is move into concepts. Now if the product concept stage does not have a basis that will allow the accomplishment of those functions at low cost, the case is lost from then on. The next we might call the design concept stage. Having a certain product concept the engineers have to break this down into certain design approaches and concepts. Unless then the optimum there makes it so that it doesn't matter what happens later on we can never get the

functions for a half or a third or a fourth of the cost. Then there follows the design of the hardware. In this area value can be lost. The manufacturing concept stage, what do we make, what do we buy, what kind of equipment. The manufacturing operation stage, the factory operation can lose it, the purchasing stage can lose it and there are certain others. If there were only seven of these in series and if each one got 90 percent of proficiency, this would mean less than 50 percent total proficiency 90 times 90 times 90. Therefore, it is easy to understand why half of the cost in essentially anything on the average is unnecessary and when techniques such as these are applied, it is found to be true. Another reason is that any product is filled with so many decisions. Our Vice President of Engineering looking at one product said, "I know there are over 100,000 decisions that went into that." The decisions in the contract, what kind of materials, how big, what kind of backing and the decisions in everything else. Each decision is made at different times under different conditions, with different knowledge and different limitations. The components that you people have in this fine system have decisions made 25 years ago, 20, 10, and 5. Hundreds of thousands of decisions. Updating those decisions at any one time helps to get a tag on an awful lot of unnecessary cost.

Let's move a little closer to the human area. Each of us as human beings looks at other things through a screen, and this is very real. We have experience with certain types of plastics and its good or its bad and it affects our judgment of it, especially if we have had a failure experience. We have experience with a certain type of machine. We have been embarrassed by the boss because something went sour that we tried a number of years ago. So we develop a screen that is by no means objective, and every bit of unobjectivity in this screen either introduces

performance or more cost in all of our decisions. Recognizing that we can make tests to ferret out the poor performance, about the only thing that stays in is the poor cost, the higher, unnecessary cost as a result of our screens. Then these screens plus the way men work together create a system of roadblocks all through each organization. We don't know any better word for it: The man who is a specialist in tool engineering in an area has certain beliefs. Some of them are wrong, some are dead wrong because of his screens and his experience in the advance of the art. Still he makes up that type of decision. So with these function-based techniques we attempt to find an objective way to get a look at what is really needed and overcome these roadblocks. Then, two more things.

One is information lack. We know that with the exploding type of technology no man at any time and place could hope to have half of the information that would apply to the particular thing he was making a decision on; and just as important as that, but a little more obscure, is the idea lack. Until we have an idea it is just as obscure as though it did not exist, and after the idea comes it looks so simple and is often so embarrassing. We say, "Why couldn't I think of that simple engineering idea ten years ago?" And this isn't so bad if we say it, but if the boss says it, it hurts. Perhaps one other reason. All of the cost levels of our products are established by decisions on how to do certain things. Selecting a material, or process or shape or combinations. Every decision made by a man is selecting a shade of gray. We make our decisions by three shades. An electric eye would make them just as well if we could put it into these shades. A situation comes up that we are going to decide on. It has to do with, for example, the manufacture of a part or the design of a total product or a concept on a system. First of all we look through our own attitude screen. If we have had some bad experience with selsyns, we have

a bad screen on selsyns. The same with other things. Secondly, let's superimpose the screen of what comes down from above. What does our boss want? What does the company policy ask for? What do we think those about us want? And this is extremely strong and extremely effective and there are many times when more than half controls the saving. And last is the screen that has the objective facts that we are able to get on the decision we are about to make. Looking through those three, we do it this way or do it this way. One more thought that may have been brought to you in your seminar, it's so important in decision making. We used to think that decisions were made by folks like us who are looking out for our country's best interests, and our companies and families and all on the basis of what seems best for the situation. I'm going to make a statement I don't have time to prove, I will ask you to prove it yourselves by just studying some of your own decisions. Hard decisions are made on a basis of minimizing personal loss, and this goes for every man until he gets in the position where he is completely immune to personal loss. This goes for the engineer, for the draftsman, for the contracting officer, for the managers. My boss wouldn't believe this when we first had evidence of it. 30 days later after he had tried it on some of his decisions, he now agrees. Well, enough of that.

Now, I would like to be sure that we all recognize that we do not have to have a piece of hardware to use these function-based techniques. Some of the most effective use of them is on organization, or procedures or structures. Anything that costs money. All right now we are making an extensive research of just how to use them as handily on that as we do on hardware. For example, an organization only exists to accomplish some function or some group of functions. What are those

functions? Precisely, spell them out and get them in two words the same as you people try to here. This makes very tight thinking. It's to communicate something, to preserve some intelligence. What intelligence do they preserve? For who? How long? Who uses it? Then take the next step. Put a dollar sign on the value of each function, the same as you did on the value of these functions that you showed us. When this is done in an organization it is of tremendous help. It helps to pick the places where our money is going in organization and where no real function is coming. The same is true for our service, for maintenance, for anything else that costs money. The same techniques apply for paper work. Now I want to give you just a glimpse of something that is coming. It is pretty bad to have to try to get the right cost only with the loose ends of tools that we have to work with. In performance we can look in the engineering handbooks, and we know how much current a wire will carry of a given size under given conditions and how much temperature rise, but we don't have it in value. This brings us to the point that it's time we did that and it can be had. A new development which you will see coming and you could use can go under different names. One would be the name of a value standard. What is the standard of appropriate cost related to function. These value standards can be made and are being made in the more advanced work so that the engineers will have value standards the same as performance standards to measure to, and these are credible standards not just something that an engineer is forced to just believe because so often it doesn't apply, it doesn't work out that way; e. g., if the function is conducting 100 amperes a foot, what is the value of that function? Now you all have learned that to make this word "value" useful in the working part of this, value is the lowest cost of reliably accomplishing a prescribed function.

All right, what is the lowest cost of reliably conducting 100 amperes a foot or reliably transmitting 15,000 lb. inches of torque ten feet. A relationship from functions right straight through to cost can be prepared and can be in your handbooks, and when you put together your product which you will more and more do from functions, rather than parts, there is the function, what's the appropriate cost? Here it is. Charts can be made and are being made. Curves can be made and are being made. Just to carry it a step further, all of you engineers recognize that there is still a loophole in it, because the copper bus, for example, might be in an enclosed area; it might be black or white, it might be rough or smooth and all of that affects the temperature rise carrying current, so we can have a function plus its specification and that includes these things I'm talking about. Then you can have a \$ sign--a dependable \$ sign and use it fast.

It seems to me that you would be interested in some comments on the use of this technology in research and development. I would be much less than honest if I came here and told you just the things I thought you would believe. I therefore want your opinion - I want your permission for the next few minutes, perhaps eight, to allow me to push into a little newer ground, into areas where we have overwhelming evidence of what I am now going to say is true. But we don't have the same kind of absolute and final proof and don't have a sense of use the same as the things we have been talking about in the past. So let me say up until now I have been totally reliable in everything I have told you. From now on I'm going to push a little ways in the blue. I talked to Charlie about this and Charlie said he didn't think you would discredit the things I know for sure which I told you some of the things looks like we're going to know for sure in a year or so. Now I would like to do that. In the research and development work we have stage fright. We have an inferiority

complex. We are full of complexes. We think its so damn hard. We think everybody is pushing us. We think everything is different. We think there is not enough money, there is not enough time, there won't be enough reliability, there won't be good enough quality. Problems, problems ahead and we think it so fully that we can't get a good clear look at the job we have to do. I was to one of our big operations - electronics guidance type of thing and the manager of engineering there said, "We never make two things alike here, that's our problem." Hell, I have been through there time and again but the only thing I ever see there is racks full of electronic gear and shelves and trays and I said well by gosh I want to say you never make anything different. Show me something different and so I shocked his thinking just a little and we got a little different thinking. Why, their stuff for the last five years has just been the same functions repeating and in a little different degree and a little different form. They have to have amplifiers and transformers and capacitors in the circuit and different types of units. It's the same. The only thing that's different is the state of mind. So, let's approach this with the viewpoint that what we are doing is the same thing over and over and over but we have always thought of it as different. Now let's take out the stuff that's the same and let's get some standards on the stuff that's the same and sure you may be need a little different regulator on the rectifier but it's the same rectifier. Let's get a curve that puts the value in with the different regulators. This was a very helpful viewpoint. The second thing I would like to bring out is that in research and development work, 90 percent of the job is old. There is very seldom one that has more than 5 percent of brand new technology and that's the area that has to be solved with the technology rules. 95 percent of the cost is going into the things that have nothing new in them and the

see these men doing here. I don't care much what the 5 percent of the cost - what's in that, go ahead and do it the way you want to, but let's look at the rest of it differently. It is not new. It is an enclosure, It's a support, It's something that has been made hundreds of dozens of times. Now if we get to looking at our R&D job then, for what it is, we can, in my judgment and with some experience back of it; and I told the same words to General Trudeau who in Washington is working along the lines of really getting some good value work into R&D, I told him that he could complete--if he could get good use of Value Engineering techniques by good men not a fringe thing, but something you expect to get results from--he would complete his development in 1/3 less time. Secondly, of course, they would have greater reliability because we would have better answers before we started spending any money on developing something that would work and thirdly the end product would have about 1/2 the cost of what the end product has now, which means the nations would get twice the weapons for the same dollars. Carrying along this line came the philosophy that is new in Value Engineering and that I am now going to give to you, and I expect that a year from now we will be dead sure of, right now I'm 90% sure. Instead of the traditional manner of designing, which we engineers always have taken, where we first design for our performance and after we have seen performance we go to work to get an essential or necessary level of cost, that we turn it around completely. Now when I say that this is revolting to every engineer in the class. But I fully believe it is true and that is why I'm saying it; e. g. , we will decide right back in the product concept stage what the appropriate cost is for the whole thing and then break it down by a function tree into basic main functions. How many \$ for that function? \$10,000 for this function, \$15,000 for that, \$20,000 for that. Now we start our development. Here is the solution that would do this thing if we

can work out some bugs for \$100,000. Forget it. Here's what we call a quick rejection principle. It's not the right path. Here's another one. Here's another one. Here's another one. Finally here is one that looks as if it would do it for \$5000, \$6000 or \$7000. Right, put our time, put our development money on that. This has worked to a surprising degree on a number of products where I've seen it work. What it does instead of allowing time and money to be chewed up by taking the 1st, 2nd or 3rd idea an engineer has and like Topsy try to grow it, and debug it and make it work. You stop right there and think harder and think sharper and get more help and start out on a concept that will come within the cost budget and then the first time we get performance we've got them both. So I am suggesting to you that revolutionary and totally different approach, which is a Value Engineering approach. Had the men told you more about how they approached their jobs they would tell you they put a value on functions. Value in effect does that. Here is a support for 100 lbs, they would determine a support for 100 lbs. is worth \$1, but now they are setting the cost first. They rule out all of these costly things that would do it for more than \$1. Pretty soon they have got an approach that looks like it would do it for a dollar and away they go, saving time and money and getting a better answer.

I'm changing the tone a little. Now, I'm through with that. I want to tell you another experience that I feel is very significant. Some of our engineering managers a few months ago said to me, "Larry, why is it that we always underdesign no matter how many engineers we assign to a project?" Well, the first part of his sentence I could understand but when he tacked the last one on he kind of threw me for a loop. I thought I would have to think a little about this. And then we talked about the design process and I leave out a lot of steps, but I'll tell you the result and I'll tell you the experience. In our discussion then we started this way. What

does the design process have to do? It has to do two things. It has to get appropriate performance and appropriate cost. What is it that an engineer doesn't have?

Well, he doesn't have appropriate cost. He keeps on it until he makes it good.

OK then, what is he lacking? He is lacking some necessary work that the product demands to help him get costs and he doesn't have them. How do we remedy it?

We decided to take four tables, and we just take the table as a unit, and we would put the responsible engineer in the middle of the table and we would set a value trained and experienced engineer right next to him. If a product has too high a cost that's the technology of value engineering that is used. If it's too heavy then you need another technology, you ought to have somebody else helping. If it won't run at high enough temperatures, then you need a high temperature metallurgist. So we put the Value Engineer here. Then we put one other man next to him and this other man was a materials man at one table, a mfg. engr. at another table, I've forgotten what the other two, but the men that would probably be most needed. Now here's the job. The results were just remarkable. It was on a highly competitive job that was a good profitable line, and costs were considered good. This was started in January and the stuff in the production line in October. As the result of these four figures between 30% and 35% of the cost removed and it was a better product, they had more features added in. So now they say what we did is take the engineer and put him in an environment where he has a good chance to do his job in today's type of living.

While I'm talking about that let me just mention for a minute the use of value consultants. Many of you have had two weeks of training, but that doesn't make a value consultant. That gives you a tremendous kind of a chance to jump into these techniques and to approach things from a functional basis. We feel that after about a year with some advanced training a man will pick up enough skill so that he could

be called a Value Engineer or a Value Specialist as his full time work, and whenever he is called in by some engineer he will make the same kind of satisfactory contribution that the high temperature metallurgist will when he is called in, or the stress analyst will when he is called in, but you fellows have just started; you will want to build up. Furthermore, in order for anyone to use a specialist the engineers must know what the specialists can do. We want all engineers to learn some about metallurgy, we want all engineers to learn something about Value Engineering techniques, what you people have learned here. But then we want some more, enough of them to really know it in detail.

I think now I will drop back to the questions you folks asked and supposing I take the easiest one first and after I answer the questions I have a little conclusion and then I will take any more questions if we have time for it, either from the floor or afterwards:

First, what is the difference between Value Analysis and Value Engineering? The term first applied by our Vice President of Engineering was Value Analysis. He said you are fracturing both performance and cost. He says it would be wrong to call it performance analysis; it's certainly wrong to call it cost analysis. Because you are considering both, he says it's Value Analysis. Then as engineering people started to use these techniques and strengthen the ones that worked in engineering they started calling them Value Engineering which is a most appropriate name; but we do not allow that name to be used by anyone who is not actually an official engineer. If they are not an engineer they are Value Specialists. Consider them synonymous.

How can management get the feedback to know when it puts a product in that it has a good enough level of appropriate costs? Well, let me take a comparison to something we know something about. Years ago the tax structure was not too high

so we didn't have specialists in income taxes. We expected good accountants handling our company's business to make out the income tax report. Then as taxes became so important it became important for the company to have specialists who have a real depth of knowledge in tax cases, tax law, and tax structures and how to do the tax job. So now I am sure that all companies of any size have special people and depend on those special people to either make up the report or review what is making up or give guidance ahead of time so that management will know we are not making any big blunders tax-wise. I am sure that the same is true as the best answer I can give to your question, as the Value Engineer learns his technology and does it correctly he will know enough, and must know enough, to assure management that enough of the unnecessary costs are out before they sew up the design and go into manufacture.

How important to engineers are costs? Good night! This one almost makes me explode but I am trying to contain myself. Meaningful costs have the same importance to any decision-making man who must get appropriate cost as one of his main jobs, that meaningful tests have in order to get performance. Any man making decisions has, if he has to get them both, performance - he must have meaningful tests, appropriate costs - he must have meaningful costs and that doesn't just mean some broken out costs or something where you take average overhead; they must be meaningful. They must show how the business is affected by one alternative vs another. This sometimes is a two-months' study for a man or two in a particular business to find out. They will not be the costs that are on the books but they must be meaningful. You don't have a Chinaman's chance of getting decisions that bring you an optimum of unnecessary costs. So you asked one question

Now the question of how do we motivate design people so that they, being subject to all the other pressures there are; the boss wants to cut your budget, the sales dept. wants to cut your time and there are a dozen more people who want to take something away from you, now how the devil are we going to say, "Now wait a minute, wait a minute, wait a minute; think more and start off different?" I can answer this on a basis of competitive products and supposing I do that and then you make the transition to military. In competitive products there is no chance whatsoever of bringing strong enough pressures to bear on any group of engineers or manufacturing people or purchasing or their equivalent to cause them to put enough time and good techniques in to get out important amounts of unnecessary costs unless the manager who is personally accountable for profits tells them so, and not only tells them so, but shows them by his actions and decisions that he considers profit just as important as shipments. In most companies, the president is the lowest level man who is definitely accountable down on the sheet for profits or no profits. Engineering manager has to talk a good line, manufacturing manager has to talk a good line, purchasing has to show they are doing good, but when you get to the President he's got it or he hasn't. Now, if this man tells people, "I want it", then it's no harder to motivate than to get good Value Engineering than it is good performance engineering. So it has to start right there. Now I expect in some form, even on military work, this pressure has to come but you people in top management, I can't guide you much there, but I am sure you don't need guidance.

How do we relate cost performance schedule and other items? How do we keep them in the proper perspective? Perhaps one clue there is, if we will start off with the basic concepts that will give us the right cost and not chew up our time

probably can get them all. Otherwise it's a case of resolving the forces that are put upon a man, and it has to be up to management to determine where to put the force. How does this apply in preliminary design? I think as you have seen the first place where the technology of Value Engineering can apply is after it has been decided what functions a customer wants to buy. Right at that time a certain amount of Value Engineering guidance is needed to help select the right concepts, and then following on through. In a number of more established areas, Value Engineers never work on an assignment unless called in by the marketing man if it's in sales, by the engineer if it's in engineering, manufacturing man if it's in manufacturing. Then they are used just the same as any other functional specialist. There are no problems connected with using them that are not connected with using any specialist and we've learned how to use specialists. We couldn't begin to get the kind of performance we have to if we didn't.

Now I would like to conclude by just summing up a few things that I feel are very important. First, Value Engineering consists of approaches and techniques to identify unnecessary cost. They are search techniques and problem viewing techniques; they are not knowledge techniques. They have no knowledge in them to solve the problem. They cause the knowledge technologies such as mfg., engrg., and others to be drawn in to the extent and at the time needed to bring these answers that you sought. Secondly, the job is to get enough people very skilled in using these search techniques; creative techniques, and in identifying the problems that will bring these knowledge things in. Next, we start at the early stage I just emphasized that. I've just a thought on competitive work that I hadn't said before but I will put it in the conclusion anyway. And that is that profit can never be added to price. Either we have no profit on competitive items or we take it from cost. I have

seen no exception to this and we have found this to be a very effective motivator of our management.

Then I would like to close by a statement made by one of our managers who took a Value Analysis Technique Training Course. After he took it I said, "I think you are in a position that has been occupied by no one before. You are a manager, you have high responsibilities; still you have taken two weeks and taken this course. You now know you are an experienced manager and you know these techniques in depth. I want you to give me one statement of what you think is the greatest benefit what will come from them." And, incidentally, before I asked him this he said he was most enthusiastic and he felt that this held the answer to most of the problems he had in his department which were getting an adequate profit. The statement he made was, after he thought a little, "I have learned through the use of these techniques, that they get me to look at a problem differently, to take nothing for granted." And I believe you men have been learning the same thing as they have studied these problems.

Thank you very much.