

# THE FUNDAMENTALS OF VALUE ENGINEERING

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This story is written for professionals. Thus the details of essential use of functional thinking, creative problem solving, and search processes are not included.

## I. WHAT ARE THE FUNDAMENTALS OF VALUE ENGINEERING?

1. Get a chance to work on the job.
2. Use a complete system to achieve the needed results.

It is a great misconception to believe that a business or organization or management group wants, and is prepared to receive and use, specific problem solutions which will maintain or improve product or service quality and will do so by ending costs which the organization is accustomed to paying. To consider the aspect of "getting a chance" to contribute, the attitudes and feeling—which heavily influence if they do not control decision making at all administrative levels—must be understood.

## II. THE CHANCE TO DO THE JOB

### Understanding Decision Criteria of Management and Administrative Groups

Any management group, engineering group, maintenance group, manufacturing group, or other has developed a pattern for accomplishing certain results by certain procedures.

This can well be compared to a system of piping in which there are various sizes of pipes, various junctions with various series and parallel paths in the system. Normally, a definite flow or output which varies between some customary limits has become "accepted" by usage.

Each element, were it animated so that it could talk, would feel that an effort to secure double the

output would cause strain and pain in its part of the piping system. Similarly, when it is proposed to secure better products for perhaps half the cost, each element would be understandably apprehensive and operate on the basis of "feelings" which are decidedly negative.

The specific situation must not be confused by the fact that in human situations each person will say, and believe, "We certainly do want to eliminate all unnecessary cost and I will do everything in my power to help."

Experience has placed an interpretation on this statement that what is really meant is, "Yes, I believe there is considerable unnecessary cost in what we are doing but it is not my part of the operation because I have had it studied carefully. I will certainly consider it part of my responsibility to help you find it—in the operations of others—and will provide such support as I can to help end it."

Each man in an organization (or social or cultural group) must *do what is expected of him* or be prepared to face embarrassment. Avoiding embarrassment seems to motivate his minute-by-minute thought and action more than almost any other factor. If he does more, or less, or differently, some of the many forms of criticism or ridicule or embarrassment will come for his superiors, his peers, or his "friends."

As long as he operates in the "expected" range—in *all* of his activities and relationships—he is relatively free of embarrassment. What his "environment" believes is "good practice" he must believe. What his "environment" believes is bad practice, he must believe. He must largely accept what, in his environment, is considered "facts" as facts. He must largely accept the assumptions which are believed by his "environment" to be valid.

He must not "reach out" in thinking or searching further than the pattern set by his "environment." All change involves some risk—but he must not take more risk than the pattern of the environment permits. Often he may not even investigate a method which has been condemned by his environment without high risk of embarrassment. Furthermore, he must not start or take part in any action which might embarrass his boss.

Already in each organization there exists someone who believes the group expects him to:

- Use the newest methods
- Use the best methods
- Create the most ingenious practical designs and systems
- Provide the best layout
- Assure maximum maintenance benefits
- Provide the most attractive appearance
- Find the best sources of supply
- Negotiate the best prices

Were a large improvement, which could be simply made, provided—which did not require the use of a material or process not hitherto available—doubt would be at once cast on the management and administrative abilities and skills of the present incumbents.

As these members of management evaluate the pros and cons of assigning funds and including a value engineering activity, they are in the position of evaluating alternatives which might be divided into three main classes:

1. No significant benefits
2. Very small but worthwhile benefits
3. Very significant and startling benefits

1. *If no significant benefits result:* (a) They are subject to various forms of embarrassment from superiors and peers for approving the expense; (b) if higher management has insisted<sup>a</sup> on the addition, no embarrassment to them is involved.

2. *If very small but worthwhile benefits result:* They face no embarrassment whether the action was voluntary or pressed from above.

3. *If very significant and startling benefits result:* They are subject to real embarrassment from their superiors and peers, and—personal loss from their superiors.

Scanning the probabilities from the administrators viewpoint shows that there is much more opportunity for loss than for gain. It is therefore quite understandable why the decision is usually to avoid

the addition of Value Engineering unless the pressure from a higher source—which has a demanding need for more performance per dollar—is very great. Then, when Value Engineering is added, its scope, its range, and its resources are limited enough so that its results will be small, falling into Classes 1 or 2.

It is vital not only in order to achieve initial opportunity to start Value Engineering in an organization, but also in order to provide opportunity for success in problem solving and in implementation, that information and understanding be "grown" in the management area and that their acceptance and action be secured.

### **Communicating, Developing Understanding, Gaining Acceptance, Securing Action**

Communication must start by showing "what Value Engineering is." Then, at the proper rate, this understanding of "what it is" must be deepened. Some "how it works" is included but this bears so closely into the individual work of the men in the environment that it at once starts to produce feelings of insecurity and fear of embarrassment. Therefore, the "how it works" communications must be handled very professionally.

Information, understanding, and acceptance are necessary but they are not enough. Action must follow. Action follows need. A need must be created by some means—"action of the enemy," "startling, unusual development," "determination from higher management." This need must be so severe that it enters the decision making of the individuals in the group. Then the uses of these methods and techniques by the "do it" people with the guidance, support, and active participation of the administrative decision makers will achieve results of a magnitude equivalent to the need.

Summarizing—because there are techniques in the Value Engineering System to assist in the development of better cost oriented decisions in the work of management, of engineering, of manufacturing, of purchasing, of sales, of accounting, and all others, each man views this to be, and "feels" this to be, a competitor.

The basic situation felt, then, is one in which we are saying: "Here is a competitor; we believe he has some techniques in your area which are a little better than yours; accept him, give up some of your space and your nutriment to him, and learn to love him."

In this mental framework it can well be understood that gaining acceptance requires considerable

time with very carefully chosen, scheduled, and presented communication.

It has been found that acceptance is promoted by developing the technique and method in considerable depth to an important degree of understanding while at the same time, "growing" the correct concept that this technology is a "coaching" for the professional. It would be useless for the man who was not already good. It would be worthless for the organization which had a dozen ills. But its precise strength is in good use in the good successful organization—to enhance the organization's achievements in the area of cost-oriented decision making.

### III. THE SYSTEM

Value Engineering is a system which has one specific purpose, which uses available technologies, procedures, and methods which modifies and uses others and then establishes a few which are new in order to effectively provide single purpose results—the efficient identification of unnecessary cost.

#### The System Is Like:

*The automobile*, which has the purpose of transporting weight under specific conditions. It uses existing wheels, engines, fasteners, materials, and functional products by the score in one specific system to accomplish one specific result. To achieve this result many existing parts were used as-is, then perhaps the wheels and the engine were modified, and a few new parts were added. All were integrated into one effective system.

*The airplane*, which in general terms, has the same purpose as the automobile. However, its function is more precisely defined as transporting weight greater distances in shorter time. It uses many of the components of the automobile: the wheels, the engine, the control systems, etc. However, to efficiently accomplish its exact purpose, many of its components are modified and a few new ones, such as the wings, are included in the system.

Furthermore, as high efficiency in accomplishing single purpose is achieved by improving systems, it was found that specific training must be provided. Men who use the airplane must know its capabilities, its specific needs, its strengths and its limitations. They must use it correctly, else it would not be as effective as the automobile and would be decidedly more damaging.

*The jet*, which uses thousands of the same components. However, a few, again, are modified and a few new ones are added. Again, as we progress in

effectiveness for accomplishing specific tasks, we must progress in training men to utilize these increased potentials.

Another very significant item now becomes clear, namely the "environment" in which the new system is used. The runways which had become well understood and were "common practice" for the use of propeller planes are no longer adequate. A new environment was created with specific understanding of the needs of this new system. Anyone who endeavors to develop the potentials of this new system without having the proper runways—suitable area preparation—will, of course, find that it is worthless and probably will be involved in major or minor disasters while arriving at this conclusion.

*Sheet music*, which is a plan showing precisely how each type of accomplishment is to be achieved. It is prepared in detail, step by step, showing what must be done, when it must be done, and precisely how it must be done in order to achieve an efficient and effective overall result.

*The telephone*, which is a system of common components, of modified components, and of a few very special components created for its precise purpose. It accomplishes that purpose with overwhelming effectiveness as compared with other means for accomplishing that exact purpose.

Consider now a telephone in which one or two very small wires or parts are omitted. It might be made worthless or its efficiency might be reduced by 90 percent or by 50 percent. It is sometimes said that the needed wire which does not exist is the most important wire in the system. This similarity will grow in meaning as it is seen that often very small inclusions of some necessary understanding or information or procedure or step in the process of cost-oriented decision making yields extremely large benefits.

The Value Engineering System, then, has each part needed, properly arranged and ready for use. It has trained operators who know how to use all parts. It must cause to be established a "working and decision making environment" in which its full potential can be realized.

#### Philosophy—Approach

1. *Make more objective.* Establish procedures, techniques, and systems which will highlight the objective data available or obtainable on the specific situation.

2. *Get into basic factors.* Reduce each consideration to extreme basics in order to as far as possible retard the effect of tradition, habit, attitude. What

are the absolutely basic factors which are being dealt with? More clearly see and understand the basics. Study these basic factors more deeply. Divide them into subbasics or parts of basics; regroup them into different basic factors; associate other basic factors with basic factors. Build up a logic, an understanding, and insofar as practicable, a "feeling," all based upon basics.

3. *Divide into mind-sized steps.* The individual requires a view of his objective but he then must have steps, one at a time, which are "his size" so that he can deal with them and reach the objective. Each step must be made on a basis of basics—objective material—pointed precisely toward the objective, then followed by other steps which will, when accomplished, achieve that objective.

4. *Improve the information.* It is traditional for each man to gather a considerable amount of information before starting an important project. Experience has shown that he does not gather enough; that there is usually very pertinent information which he does not have. At the same time, a part of the "information" which he does have, and which he believes, is not totally true.

5. *Improve the assumptions.* Considerations are carried out in the framework of the information and assumptions at hand. Experience has shown that vital assumptions are not 100 percent correct. Certain assumptions are made which further investigation shows to be faulty. Improved assumptions are very essential.

6. *End generalities.* It has been found that probably the greatest reason for stopping beneficial cost oriented decision making is the general statement. General statements must be given "zero" credence. What is the *specific* situation? What *precisely* does this do? Under what *precise* conditions? *Precisely* how often? *Precisely* what metal did not work under *precisely* what conditions? Generalities maintain the status quo. Specifics support new and better solutions.

7. *Cause search.* Today, no one library, laboratory, or professional group of any type contains all of the information which would have a beneficial bearing on an important problem. The amount of this which becomes available and can be used in creating the best solutions is directly dependent upon the skill of search. Experience shows that search can be decidedly improved.

8. *Cause creativity.* In possession of basic thinking, with work divided into mind-sized steps, with improved information, with improved assumptions,

some significant results of search are practical. Specific subproblems can now be attacked with intense and skillful creativity. This, in essence, is combining bits of knowledge into new combinations in a directed framework which will promote solutions to the specific problem steps.

9. *Recognize and end roadblocks and "stoppers."* The experienced have learned to expect a whole family of stoppers to immediately confront the consideration of a new approach, the test of a new approach, or the use of a new approach. The definite and proper treatment of roadblocks is just as vital as the proper treatment of the technical factors involved. One roadblock or stopper anywhere in the entire process can greatly reduce or end the possibility of results. These roadblocks or stoppers appear in securing an understanding of the problem, in securing information, in learning what the customer really wants, in learning how to bring the best out of specific materials or specific processes, in getting good, creative ideation, in getting samples, in getting tests, in getting interpretations of test material.

Roadblocks which stop the small, individual steps are just as damaging as the roadblocks which stop approval. Each must be recognized and dealt with in a manner that ends or minimizes its destructive potential.

10. *Cause better cost guides to be developed.* There are two overpowering requirements for competing in today's military or industrial competitive race. One is the securing of appropriate performance and the second is the securing of appropriate cost. For a few decades, very good aids and measures have been provided to aid decision making in the task of getting appropriate performance. Now, as it becomes necessary to achieve much higher standards in the amount of performance which is secured per dollar, the same sort of guides or measures are needed for cost oriented decisions.

The Value Engineering System contains procedures for the establishment of measures *which are not based upon experience and tradition*, but are rather based upon inherently basic and pertinent factors. Other guides and measurements are based upon appropriate search and comparison. The quality of the cost-oriented decisions is in direct proportion to the quality of these cost-oriented measures.

### The Value Engineering Job Plan

The framework which is used in identifying the problems which must be solved, making them sufficiently specific so they can be solved, and

effectively establishing new solutions, is known as the Value Engineering Job Plan. This Job Plan will be explained in detail later in this session during the Demonstration Workshop of Value Engineering in Capsule.

This approach organizes all resources for problem solving—whether large overall or small and specific. It is repeated until the needs of any specific situation have been met.

#### IV. SUMMARY

1. Value Engineering is a one purpose system of techniques and procedures. That purpose is the efficient identification of unnecessary cost.

2. A surprising amount of opposition by administrative management is encountered. The reason is found in the basic nature of men and of "men in organization" situations.

3. Information must be communicated.

Understanding must be developed.

Acceptance must be "grown."

Action must be secured.

4. Accomplishing this is a very difficult task.

5. Value Engineering is an overall system providing step-by-step procedures to efficiently identify elements of cost which would be, or are, making no contribution to the performance the customer needs or wants. It operates to first make crystal clear precisely each function that is needed or desired; second, to establish an appropriate cost or measurement for each function, or each group of functions; third, to apply necessary knowledge and creativity to accomplish each function or group of functions for that cost.

6. The system contains many *known* technologies and methods, a few known techniques *modified*, and a few *new* approaches and methods.

7. Since there are changed techniques and some new techniques, very specific, definite and thorough training is required before men can successfully use it.

8. Definite changes in human attitudes are required. To achieve this, orientation, education, and great perseverance are necessary.

9. The system includes techniques and approaches which provide "mind-sized" steps in proper sequence for all types of work. The skilled man uses the particular techniques and approaches which are needed to efficiently solve any type of job.

10. Extensive steps are taken to get all thinking into basics, to cope with tradition, personal "mental safety," roadblocks, and other deterrents. Some good

alternatives which are rooted exclusively in basics are identified. Basic thinking must carry through to the point of action.

11. Each small or large problem is solved by the processes in a Job Plan, each to be done thoroughly to the extent needed in the particular problem.

12. Training and work develop knowledge and skill in the use of the procedures by competent practitioners at a planned, predictable rate.

However, the elimination of cost means change, and the "feelings" of human beings are immediately "suspicious" of change. Hence, the task of informing, orienting, providing understanding to, securing the acceptance of, and action from, managers at all levels and men who have not had the precise training, is one which requires much planning, real skill, and real art.

#### V. SPECIAL COMMENT

Although *details* of technique were not included in the text because it is written for professionals, it is important that any casual reader know that the entire system is rooted in "function." Hence, a small indicator of function-based approaches is here included.

*Function-based thinking.* Exactly what function does the customer need, want, and want to pay for? Divide this function as to type into use function, which performs a use for the customer, and aesthetic function, which pleases him and causes him to buy this particular one. Divide function into basic function—that function for which the user has secured the device or system or service, and second-degree functions, those functions which must be accomplished because of the particular choices which have been made as a means of accomplishing the basic function.

Subdivide functional products into very specific single functions. Group and regroup functions into very specific function groups. Associate cost with each individual function and each group of functions. Establish this cost by one of a series of valid comparisons, never to the past cost but rather to costs in other industries, other types of products, other similar operations, etc. Special technique is taught for accomplishing this purpose. This is one of the new approaches which was found necessary.

Through the process of clearly identifying and understanding these functions, arranging them in the proper sized groups for best handling, and establishing appropriate cost for this function or these functions, a proper cost or measurement which is called function/cost measurement is prepared.

The function or group of functions now have not only traditional performance specifications but also the new function/cost measurement which is, in effect, an economic specification.

Search out, secure, and use sufficient knowledge

with sufficient creativity to achieve these measurements.

Make each problem a proper solvable size by clear identification, by suitable singling out or suitable grouping.