VALUE ENGINEERING IN PRODUCT DESIGN TO IMPROVE WORLD COMPETITIVE POSITION

by

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COMPETITION - NOW THE FACT OF LIFE

While traditionally it has been necessary for the designer to handle performance factors well, the opposite has been true of cost factors. It was only necessary to provide fair handling to them. The competitive nature of the future has changed this. It is now necessary that the designer handle both performance factors and cost factors well.

A product or a system is considered to contain value if it has appropriate performance and appropriate cost. The designer's task then is clearly set. How will he proceed to utilize a minimum of time, of resources, and of cost to create a design which will meet both requirements?

Areas of total newness in which no means for accomplishing a function is known, are not included in this paper. Included, however, are every product or system in which one means of accomplishing the function is previously known.

THE TASK

The task then is...

...design to meet suitable functional specifications.
...design to meet suitable economic specifications.

What <u>function</u> objectives are to be realized?
What <u>economic</u> objectives are to be realized?

THE METHOD

At this point, a radical departure from past practices will be presented. Experience has shown that it secures better results.

> The designer will design first to satisfy cost, second to satisfy performance, always "staying with" his task until he has created solutions which fully and reliably accomplish the total required function.

Step I

Precisely what are the functions required from the system or assembly?

Under what conditions of life, vibration, corrosive environment, weight, noise, shock, pressure, and so on, must each function and each supporting function be performed?

What departures from or improvements upon past performance are desired?

What other performance factors?

Step II

Precisely what over-all cost is required?

What maximum installation cost? operation cost? maintenance cost? and other costs?

Step III

The designer prepares to reject approaches which do not meet these cost factors as quickly as he will those which do not meet the performance and reliability factors.

With the advent of the special "search" and "quick rejection" techniques of the value engineering technology, a high order of results is being secured through the use of the "cost-first" approach.

The designer is faced at the beginning stage with an entire field of choice--choice which will govern how time and resources will be committed in the design process. Prompt rejection of approaches is vital. Proper choice of design approach or direction may mandate either success or failure of the product, or system, or enterprise.

My young son, while studying his geography and while further being fascinated by the space developments, pictured himself as standing near the North Pole and was discussing what he would see each hour as he looked in the direction of the sun. I asked him how long it would take him to go around the world if he were standing near the North Pole. I was pleased at his answer that it would depend upon which direction he went. If he chose east it would be a few feet. If he chose south it would be 25,000 miles.

I was somehow struck by the analogy between this situation and that which exists when we, as designers, choose the approach which we will take to accomplish the functions required of a system or an assembly. Expanding a little on what he said--it was...depending upon the direction chosen, the distance around the earth would be somewhere between 25 ft. and 25,000 miles. Similarly, depending upon the approach taken at the inception of the system or assembly design project, the result may readily vary by a factor of 3/1 reliability-wise, 5/1 cost-wise, and 2/1 time-wise.

What is the designer, in making choice of the system approach and the assembly and product approach--which so heavily govern the end results of the design process--to use for criteria?

EVALUATE THE FUNCTION IN DOLLARS

A significant contribution in establishing proper cost objectives, in developing proper confidence in them, and in achieving them is provided by the process of "evaluation of a function" in dollars which is a contribution of the new technology of value engineering.

In this process, when each function and each subfunction has been clearly understood, it is assigned a value in dollars on the premise that "the value of a function in dollars, is the lowest cost which would reliably product it."

Techniques of value engineering provide procedures for accomplishing this.

In this process, the function or group of functions to be evaluated are brought into a value system where meaningful cost comparisons are made. After one set of alternatives stands out as being the lowest over-all cost which could be made to reliably provide all of the functions and which would meet the cost objectives, it becomes the basis for the "value of the function in dollars". The cost of this alternative is, at least pro-tem, considered to be the value of the function in dollars. In a moment we will show how this drastically reduces the exploration and decision area in the design logic causing the work, time, and money to be spent in solving the problems of the alternatives which will have the lowest cost, most simplicity, and best reliability. However, first an example of evaluating a function will further clarify.

USE THIS FUNCTION VALUE

The function of basoline tanks for Navy landing craft is to reliably contain 200 gallons of gasoline. The noncombat life is eight years. The thinking process to evaluate this function is...

...what is the appropriate cost for housing 200 gallons of gasoline?

...use four 50-gallon standard drums	$25
...use one standard 250-gallon oil tank made for domestic use	$30

However, some environmental treatment and perhaps some extra connections would be required. Therefore, add............ $25

...to arrive at a tentative $50 evaluation on the gasoline-containing function.

As a result of applying the technique here...$80 gasoline containers were adopted to replace the $520 special alloy tank previously designed and used in the absence of this technique. Because at this time the mechanism of evaluating the function proceeded before other decisions were made, the saving to the taxpayers on the 1000 tanks was $440,000...the difference between $520,000 and $80,000.

Consider now the hours of design time used on the previous procurement in selecting costly non-corrosive material, designing irregular shapes which would be welded together, specifying welding methods, standards, tests, etc., only to arrive at a "performance" design costing $520. None of this "performance first" expense, or use of time, assisted in the process illustrated which, by placing "cost" first, provided the function for $80.

CONCENTRATE RESOURCES

Choices are few, resources and time will not be scattered. The blueprint for start of successful solution is at hand.

To the designer more skilled in meeting hard performance objectives than hard economic objectives, it appears that the design job has been made infinitely more difficult by the elimination of high-cost performance-producing alternatives. In practice, however, a wide range of significant benefits have already been brought into the design project:

1. The problem has now been reduced to one containing only one unknown; that is, reliable performance of the required functions. Any solution within this framework will meet the required cost.

2. The whole field which would formerly require study and selection has been reduced to one-fifth so that in far less time, thorough studies may be made within this useful framework.

3. Since these are approaches for accomplishing the functions at low cost, the constructions and processes and arrangements are forced to be essentially simple, producing greater reliability. The opportunity to use highly complex subsystems, assemblies, and procedures is, by the nature of the solution logic, denied to the designer.

4. Intense problem-solving technique will be concentrated in the few "performance and reliability gaps." Experience shows that this concentration does produce solutions which bring with them simplicity, effectiveness and reliability. An example will illustrate.

QUALITY IS IMPROVED

In a recent special program, twenty-four assemblies were studied. Twenty-one had excellent quality while three did not have the quality desired. For the twenty-one, functions were studied and evaluated. The performance and quality of all were kept, but enough better solutions to specific design problems involved in the lower cost brackets were developed to reduce manufacturing costs in all by significant percentages.

The three quality problems were handled somewhat differently. Objectives were developed to "hold cost at the same level" but eliminate the problems. The men on the three assemblies used cost first, evaluated the function, and determined that, even lower-cost objectives, were applicable to the items.

"Performance gaps" were first illuminated, then eliminated. The changes brought accuracy, quality, simplicity, and lower cost. Annual manufacturing cost of each of the three was lowered by five figures.

Low cost and high quality are often parallels. Low cost means accomplishing the functions the simple, reliable, effective way. High quality means accomplishing the functions the simple, reliable, effective way.

NEW TOOLS FOR DESIGNER

It must be borne in mind that in order to design to low cost and high reliability, the designer must believe that the objectives are attainable. The basic steps, job plan, and special techniques of value engineering provide to him opportunity to develop that assurance and guide him in doing it.

This necessary assistance comes in four types.[1]

1. Identifying, classifying and evaluating functions:[1]

"Any product or service has one or more prime 'use' functions which can usually be described in a two-word definition--such as, provide light, communicate intelligence, transmit torque; 'secondary' functions--such as resist shock, allow access, operate quietly; and 'esteem' functions--such as, provide attractiveness. Value, being a relative measure, the comparison approach must be used in evaluating functions--if there is no comparison, there is no evaluation."

2. Identifying and dealing with roadblocks:[1]

"Rules and generalities stop progress as fog stops traffic. Although there is not necessarily any tangible obstruction in a fog, it is dense and unmanageable and constitutes an effective stopper, because there is no assurance that the fog shrouds no problems. Attack each 'generality'."

3. Providing search-oriented as differing from knowledge-oriented techniques:[1]

"The technique of finding, utilizing and paying for vendors' skills and knowledge yields an exceptionally high return. Only a relatively small amount of the total special knowledge bearing on any technology exists in any one place at any one time. For several reasons, designers too often do not use it. They don't know it exists. They don't know where it is. They are unsure of results before starting the search, therefore, settle for a known though more costly solution."

4. Providing "quick rejection" techniques to minimize the unnecessary use of resources on unsuitable solutions:[1]

"For nearly every function and for nearly every manufacturing situation, there exist many alternative solutions, all of which will accomplish the

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[1]Partial quotation from "Techniques of Value Analysis and Engineering," McGraw-Hill Book Company, New York, New York, 1961

purpose. Proper selection depends upon meaningful costs. How is the business really affected? Without meaningful cost, decisions cannot be made to provide good value."

In the process of providing ideas, knowledge, and approaches in these performance gaps, the engineer will find the search systems and quick rejection systems of the value analysis and engineering techniques of great value.

SUMMARY OF PROCEDURE

1. Secure clearly defined performance needs.

2. Secure definite cost needs.

3. . Intensely study all functions and sub-functions both as to the results to be accomplished and the conditions under which they must be accomplished.

4. Evaluate functions and subfunctions in dollars. Bring enough effectiveness into this task to achieve an evaluation equal to or below the cost objective.

5. Use function evaluation to eliminate concepts and approaches which cannot be used. Commit resources to the remaining alternatives.

6. Identify the areas in the remaining system where lack of knowledge or lack of suitable ideas produce what we have called a "performance gap."

7. Pinpoint sufficient resources on these gaps to bring forth effective solutions.

CONCLUSION

Much has changed.

In Europe there exists a vast growing, unfilled market, for every type of consumer goods used in this country. European families are buying them. Their standard of living is on the rise--fast. As consumer goods are purchased, producer goods are required.

The volume of products available to the designer and producer who will learn how to handle cost factors with top skill is exceedingly high.

The task for the designer has changed. His approach is changing. When his task was 90 percent dealing with performance capability and 10 percent dealing with cost capability, it was certainly the correct approach to design first for performance, then utilize any remaining time and other resources available to improve cost factors. As this has changed progressively to 80-20, 70-30, 60-40, and now 50 percent performance capability and 50 percent cost capability, and as new tools have become available in the Value Analysis and Engineering System, the reversal of the design approach is often producing better quality, lower cost products and systems in shorter time at lower design cost.

The mechanism of evaluating functions, then using this evaluation to screen design approaches, first forces vigorous creative search, then narrows choices to a practical successful minimum. It, thus, is--another potent tool to assist the engineer to win in the competitive race.