

FUNCTION ANALYSIS AND QUALITY MANAGEMENT

This document was presented at the 1993 International Conference of the Society of American Value Engineers (SAVE) at Fort Lauderdale, Florida by Thomas J. Snodgrass, CVS, Fellow, SAVE, U. Wisc., Madison. It was published in the SAVE Annual Proceedings and is copyrighted (SAVE, 1993). Permission to upload this document to CompuServe has been given by SAVE.

Thomas J. Snodgrass is Director, Center for Value Engineering (VE); Program Director, Department of Engineering Professional Development, University of Wisconsin-Madison and is president of Value Standards, Inc. in Madison, Wisconsin, a consulting firm he founded in 1963. He serves as a consultant, advising professionals in industry, design, and construction about applying VE/value analysis (VA) to analyze functions, costs, and value of products, facilities, and services. Mr. Snodgrass has 15 years of experience with various divisions of the General Electric Company. He has conducted workshops for the University of Wisconsin since 1966. Active in SAVE, Mr. Snodgrass served as secretary of SAVE's Certification Board and as vice president of Professional Development.

ABSTRACT

Function Analysis (VE) is a proven system that assures quality in the functions that customers desire. This quality results from team participation and disciplined application of techniques that identify opportunities for providing better value. Quality management supports the system and fosters the decision making needed to implement these opportunities for providing better value.

INTRODUCTION

Kaneo Akiyama contends, "Function Analysis is both the foundation of value engineering and its most characteristic analytical technique."¹ He restricts Function Analysis to what he terms the "basic function step."

In this paper, the term Function Analysis is considered synonymous with VE or VA, and it will be written with the first letter in each word capitalized. Function analysis also denotes the fourth step in the information phase of the VE job plan. In this case, the terms are not capitalized. This fourth step is preceded by FAST diagramming, function cost, and function attitudes.

The initial concepts for customer-oriented VE were developed in research conducted by me with Bob Bartlett and Svein Hvamb, and in work done by the consulting firm, Value Standards, Inc.² Thomas Snodgrass and Muthiah Kasi stated, "Function Analysis was founded on the concept that 'a problem solvable stated is half solved' and the understanding that communication between inter-ested parties is the key to defining the problem."³

The emphasis on quality and quality management has become a major activity of organizations and is still gaining momentum. However, *The Wall Street Journal* recently printed a lead article that indicated that quality management had serious deficiencies.⁴ Kaneo Akiyama contends that Function Analysis can correct these deficiencies because it:

"Identifies quality demanded by the customer in terms of functions

Clarifies the meaning of quality demanded by customer

Makes it possible to apply quality control (QC) at the planning and design stage

Makes QC based on function properties possible in fields other than manufacturing."⁵

Successful VE studies are studies whererecommendations are accepted and implemented. Lawrence D. Miles recognized two steps for success:

1. "Identification of unnecessary cost through generation of value alternatives.
2. Decision making to effect implementation of the work or an appropriate value alternative and bring benefits into the product."⁶

Miles' first step can be accomplished using the main techniques of Function Analysis. Miles' second step can be

accomplished through the techniques of quality management.

TECHNIQUES IN FUNCTION ANALYSIS PROJECT TEAMS

Two techniques of Function Analysis provide the power that produces impressive results: project teams and a five-phase job plan. The project team provides the range of knowledge and experience essential to produce results. In industry, the team typically includes specialists who are involved with the product, such as the design engineer, manufacturing specialist, product manager, etc. Ted Fowler presents a complete examination of team selection for industrial applications, including team leadership and equality.⁷ Team selection and responsibility will be discussed in more detail as factors in quality management.

Often government contracts include a VE clause that affects design and construction. In such cases, the consulting firm selected to conduct the VE study provides a project team or select a team of outside specialists. As in industry, these specialists are familiar with the generic design and construction practices in the area being studied. Often they are assigned to review a design at various stages.

For government studies, the design engineer, architect and others who developed the design are never part of the study team. They are available as information sources. Before implementing recommendations of the study team, the designers must approve the recommendations.

This approach apparently derives from the belief that the owners of the design will not be as objective as outside specialists and consequently will overlook major areas of savings. However, this reasoning strongly suggests a lack of faith in and understanding of the power of Function Analysis and significantly impedes implementation of the recommendations. Furthermore, it is difficult for a design engineer who has not participated in Function Analysis to accept outside suggestions.

FIVE-PHASE JOB PLAN

The second powerful technique of Function Analysis is the five-step job plan. There are many variations of the plan, but they all contain essentially the same activities. I favor the following phases:

- Planning
- Information
- Creativity
- Evaluation
- Implementation

Management must assume responsibility for the planning and implementation phases. These responsibilities are detailed under quality management below. Under the supervision of a value specialist, the team is responsible for the information, creativity, and evaluation phases. The creativity and evaluation phases use techniques drawn from other systems. Because there is an extensive literature on these techniques, this paper will not cover them. However, their importance in the overall job plan should not be diminished.

The information phase establishes a communication language and a means of organizing cost and attitude data into a format for analysis and comparison. It also establishes function opportunities. There are four steps in the information phase: FAST diagramming, function cost, function attitudes, and

1993 SAVE PROCEEDINGS

function analysis. Each step establishes an important discipline to develop the foundation of the job plan.

FAST Diagramming

The first and most challenging activity of FAST diagramming is identifying the proper functions. My experience in working with VE teams and students of VE during the past 30 years indicates that identifying functions is the most difficult activity in FAST diagramming. To successfully identify functions, certain rules must be spelled out and enforced. A common error made in FAST diagramming is using a component of the product or design or a building procedure as a noun (i.e., hold bolt, join parts). Identifying the function that best describes the customers' need or desires is also difficult for many practitioners. For example, a study team addressed the problem of preventing the front-opening door of a dishwasher from leaking water on the floor. A misadjustment of the door latch appeared to be the problem.

The first attempt to describe the problem yielded the function, Hold Door. But the team then applied the technique to move to a higher level that has meaning to the customer, and asked "Why hold door?" The answer to this question generated

the function, Prevent Leak. By asking "Why?" again, the team generated the function, Protect Floor, which is the highest order function and the one most significant to the customer. The team now could allocate a group of parts, including the latch, to the function, Protect Floor. The team established that these parts were not doing the job.

Once the functions have been identified, they must be organized in a function logic or FAST diagram (Figure 1). In doing this, you identify the basic functions and the TASK. Finding the TASK, or the purpose for which the customer/user buys the product, is important. Confusion about the TASK is often caused by the emphasis of certain features, such as Facilitate Loading, Reduce Noise, Sanitize Load, which blur the real TASK of the dish washer, Wash Dishes. The four primary supporting functions common to all products, designs and services speak to the customer in terms the customer understands: Assure Convenience, Assure Dependability, Satisfy Customer, and Attract Customer. They are motivators for the buying decision and the functions that build high acceptance where the customer wants it. These function also reduce acceptance when they have non-tolerated faults.

Function Analysis Systems Technique Customer-Oriented Fast

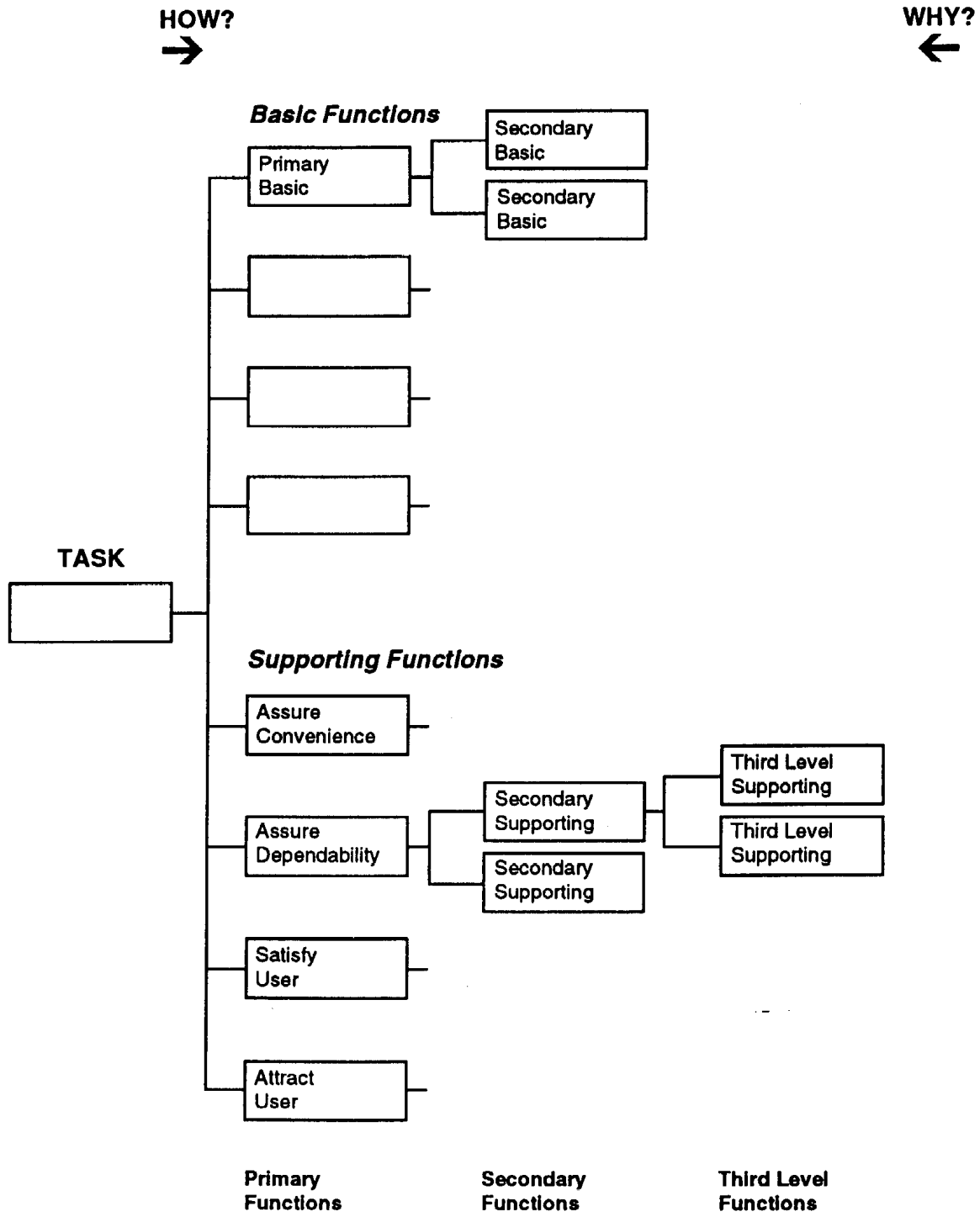


Figure 1

The second step of the information phase starts with a costed bill of material. By analyzing each item of cost and assigning each cost to one or more functions, the costed bill is transposed to function cost. These costs can be posted on the FAST diagram. Customer-oriented FAST costs are allocated to the furthest level to the right of the scope line (Figure 1). The sum of the costs of the 2nd and 3rd level functions determine the function cost of the 1st or 2nd level. Finally a total is determined for the basic functions and supporting functions. The sum of these two is posted under the TASK and is the same as the costed bill total. Assigning costs to functions can be done manually, but there are software programs that save time and avoid errors.

The key to meaningful function costs is accurate and meaningful allocations. Like function identification, cost allocation is challenging. Team members who should know characteristics of materials or operations often find they cannot answer their teammates' questions and must consult outside specialists. The more a team digs for facts, the better prepared the team members will be to propose and evaluate better ways.

Often team members take refuge in criticizing the process as too complex, a waste of time, etc. This is a problem that must be solved for the project to succeed. Snodgrass and Kasi provide a detailed discussion of function cost.⁸

Function Attitudes

The importance of the voice of the customer is now being accepted widely. Ted Fowler clarifies the determination of true worth "by directly and accurately measuring the reactions of actual users and customers."⁹

Quality Function Deployment (QFD) brought the importance of customer attitudes to the fore, and the house of quality diagram actually compared the in-house attitudes of designers with market research results. (For more discussion of

this, see my paper in which I compare QFD with Function Analysis and termed it VITAL.)¹⁰ Customer contact with a satisfactory statistical confidence level takes 3-4 months to obtain and costs money. VE practitioner using customer-oriented VE tend to depend on internal attitudes of what the organization thinks the customers' reactions are. Some modify this with focus groups representing the customer.

However, best results depend on obtaining a statistically significant sample, determining whether the customers' responses are a like or a fault, and allocating the responses to the related functions. Software programs are necessary to perform this operation quickly and accurately. Once this type of customer data is available to the team(s), there is little difficulty in performing the allocation.

It is also most important to measure the overall acceptance of the customer sample. This allows comparison of numerical acceptance of products or designs. The Chi² statistical procedure determines whether differences are significant.

Function Analysis

The final step in the information phase is function analysis. Here the team refers to detailed analysis of functions to determine where the problems and opportunities lie. The three prior steps have organized cost and attitude data into function cost and function attitude, which are now ready for intensive analysis. Hoshang Karani has done an outstanding job of establishing a four-step procedure to do this. The four steps are:

1. Determine Customer Function Acceptance High/low
2. Identify High Function Costs High/Low
3. Establish Function Importance High/low
4. Indicate Function Value Poor/Good/Unsatisfactory

Figure 2 shows the eight possible combinations.

Function Analysis Determining Function Value

Function Acceptance	Function Cost	Function Importance	Function Value	
HIGH	HIGH	HIGH	POOR	1
		LOW	UNSATISFACTORY	2
LOW	HIGH	HIGH	POOR	3
		LOW	POOR	4
LOW	LOW	HIGH	POOR	5
		LOW	UNSATISFACTORY	6
HIGH	LOW	HIGH	GOOD	7
		LOW	UNSATISFACTORY	8

Figure 2

The team's function analysis is posted on the customer-oriented FAST diagram. The functions are color coded red for poor, green for good and orange for unsatisfactory. A function colored red with a number 3 opposite indicates the function has low acceptance, high cost and poor value. A FAST diagram with

the various function values indicated is a sample of this powerful visual technique (Figure 3). The creative phase must generate numerous ideas to change these relationships, and the best ways are determined by using the evaluation phase techniques.

Function Analysis Systems Technique Power Tool

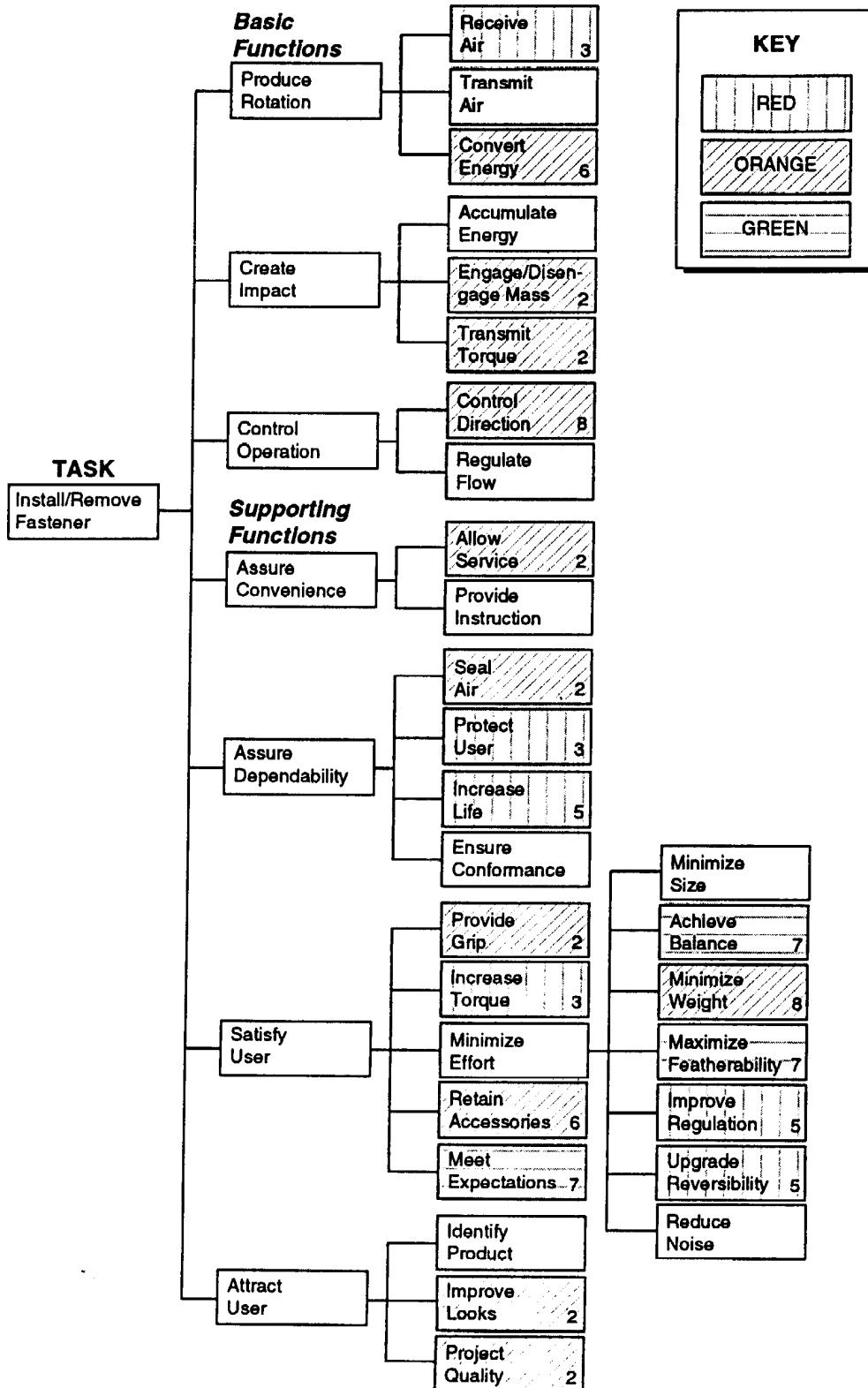


Figure 3

1993 SAVE PROCEEDINGS

QUALITY MANAGEMENT

Implementation of VE studies is facilitated by quality management techniques. The proponents of the newer technologies emphasize the need for top management support and involvement. Without these, the technologies are defeated by obstacles presented by various parts of the organization. Function Analysis is most susceptible to middle management's "honest wrong beliefs," that cause non-participation at the least and active opposition at the worst. One definition of quality is character with respect to excellence, fineness, or grade of excellence. This level of quality has differentiated my successful studies from less successful ones. Three areas must have quality management: planning, support of the value specialist in the proper application of Function Analysis techniques and rules by team members, and implementation of team recommendations.

PLANNING

Management must see the need for change, and it must be a consensus. Next an orientation on Function Analysis (VE) must spell out the techniques and management's role. The selection of the product or design to be studied must be the decision of management as should the selection of competitive makes or alternative designs. Top management from various parts of the organization must supervise the selection of the team candidates from their section and approve the schedule that spells out the time the candidate will be absent from his/her position while participating as a team member.

A budget must be prepared and approved by top management, and all proposed deviations from the initial schedule and budget should be reviewed and approved or disapproved. Someone representing top management must be responsible for assuring that the data is gathered in an approved manner and will not be open to questions when recommendations are presented.

FUNCTION ANALYSIS (VE) TECHNIQUES AND RULES FOR TEAM MEMBERS

The value specialist's role is to teach and supervise the teams, but the only motivation she/he has is persuasion. A committed and involved management can assure 100 percent participation and provide support to teams during the traumatic experience of identifying functions, allocating costs, and accepting the customer attitudes and acceptance. Management should attend scheduled meetings where teams report their progress and give each team member reasonable time to participate regardless of her/his sectional duties. No team member's sectional duties can be considered more important than another.

IMPLEMENTATION

Implementation starts with the team's final presentation. Top management must attend this presentation, and staff members who will be affected by the recommendations should also attend. Top management should review the team's recommendations and publish its decisions within two weeks of the team's final presentation.

Best results are obtained when management assigns the team(s) to follow the implementation and to report progress or problems at established times. Finally, necessary adjustments must be made to budgets and personnel requirements to support the recommendations.

REFERENCES

1. Akiyama, Kaneo (1989) *Function Analysis: Systematic Improvement of Quality and Performance*, Cambridge and Norwalk: Productivity Press, Inc., p. 7.
2. Snodgrass, T., & Kasi, M., (1986) *Function Analysis: Stepping Stones To Good Value*, Madison: University of Wisconsin-Madison, p. XI.
3. *Ibid*, p. 1.
4. Fuchsberg, Gilbert, Total Quality is Termed Only Partial Success, *The Wall Street Journal*, October 1, 1992, p. B7.

5. Akiyama, Kaneo, p. 34.
6. Miles, Lawrence D. (1972) *Techniques of Value Analysis and Engineering*, 3rd edition, New York: McGraw-Hill, Inc. p.6.
7. Fowler, Theodore C. (1990) *Value Analysis in Design*, New York: Van Nostrand Reinhold, p. 42-45.
8. Snodgrass & Kasi, p. 191-223.
9. Fowler, p. 21.
10. Snodgrass, Thomas J., Quality Function Deployment versus Value Information Techniques Using Analytical Language, *Save Proceedings, 1989*, p.99.