UNIT 14 VALUE ENGINEERING

Objectives

Upon completion of this unit you should be able to:

- understand the concept of value engineering
- differentiate between value and cost
- see value engineering in historical perspective
- appreciate the role of value engineering in cost reduction and performance improvement
- identify poor value areas in products and systems
- learn about the value engineering job plan
- appreciate the role of some of the techniques of value engineering
- study some cases to see the improvements in product value through value engineering techniques.
- identify the behavioural and organisational issues involved in value engineering.

Structure

14.1 BASIC CONCEPTS IN VALUE ENGINEERING

Value Engineering and Value Analysis

Value Engineering (VE) or Value Analysis (VA) is an important and powerful approach for improvement in the performance of the products, systems *or* procedures and reduction in costs without jeopardising their function. The terms VE and VA are used almost interchangeably. Other terms used to convey the same concepts are Value Assurance and Value Management (VM).

L.D. Miles defined Value Analysis in his book Techniques of Value Analysis and Engineering (1961) as "an organised creative approach which has for its purpose the efficient identification of unnecessary cost i.e., cost which provides neither quality, nor use, nor life, nor appearance, nor customer features". Various other definitions are proposed such as "an organised systematic study of the function of a material, component, product or service, with the objective of yielding value improvement through the ability to accomplish the desired function at the lowest cost without degradation in quality". Thus the basic objective of VE/VA is to achieve equivalent or better performance at a lower cost while maintaining all functional and quality requirements. It does this largely by identifying and eliminating hidden, invisible and unnecessary costs. We may simply perceive VE as the systematic application of recognised techniques to identify the functions of a product or service and provide those functions at the lowest total cost.

Value Engineering should not be treated as a mere cost reduction technique or cheapening of the product. It is more comprehensive and the improvement in value is attained without any sacrifice in quality, reliability, maintainability, availability, aesthetics, etc. It was traditionally applied in the area of hardware projects, such as product design, though these concepts are equally applicable in software projects, in

the systems and procedures. Recently these concepts have been applied to non-traditional areas such as urban slum development programmes, staff welfare motivation enhancement and courtesy improvement plans.

Reasons for Poor Value

One of the important reasons behind poor value in products, systems and procedures that we come across is the lack of organised effort in devising such systems. Many times the designs are created under highly compressed time frame and the designer may play safe by giving product designs with sole emphasis on technical feasibility and may prescribe thicker, costlier materials and other unnecessary features which are not needed by the customer. Sometimes, ad hoc decisions get permanency due to lack of review of product designs. Often lack, of consultation with others contributes to poor value. Lack of information, wrong beliefs, habits and attitudes are some of the other reasons.

14.2 HISTORICAL PERSPECTIVE

Value Engineering had its origin at the General Electric Company (GEC). As a result of World War II, many materials were in short supply and L.D. Miles was associated with a committee to identify substitute materials without sacrifice in quality and performance. He organised a formal methodology in which a team of people examined the functions of products manufactured by GEC. Through team-oriented creative techniques they made changes in products to lower their cost without affecting their utility and quality. This methodology was given the name Value Analysis (VA). L.D. Miles who wrote his book in 1961 is generally recognised as the father of Value Engineering. Miles found that many of the substitutes used were providing equal or better performance at lower costs.

The first organisation to initiate a formal VE programme was Navy Bureau of Ships in 1954. In 1959, Society of American Value Engineers (SAVE) was set-up to propagate the philosophy of Value Engineering. Many companjes in USA, UK, Japan, etc. subsequently set-up formal VE programmes. The Department of Defence in US encouraged application of VE in defence projects.. A number of success stories of VE/VA are reported.

In India, VE/VA is now a well recognised programme and many organisations in;. military and navy as well as in other public and private sectors have set-up directorates or cells of Value Engineering. A professional society Indian Value Engineering Society (INVEST) came up to create awareness in VE/VA and they publish a journal, organise conferences and provide other services. It is now considered as an effective management tool.

14.3 FUNCTIONS AND VALUE

Types of Values

The term `Value' is used in many different ways and is frequently confused with the monetary price or cost of an item. However value is not synonymous with cost. Value maybe perceived as the ratio of the sum of positive and negative aspects of an object. Thus value can be considered as a composite of quality and cost. It is more in terms of worth or utility. Thus a ratio of quality to cost can be treated as the value of a product. If its costs can be reduced for same quality or quality can be improved with same cost, then the value improvement can be said to occur. The term value can be divided into following types:

a) Use Value: The properties and qualities which accomplish a useful purpose or service.
b) Esteem Value: The properties, features or attractiveness which cause us to want or own it.
c) Cost Value: The sum of labour, material and various other costs required to produce it.
d) Exchange Value: The properties or qualities which enable us to exchange it for something else we want.

Types of Functions

VE discipline deals with the functions of items, products, systems and procedures. It is a functional approach, a customer-oriented approach. Identification of the functions, therefore, constitutes an important aspect of VE. The term `function' is used to mean the purpose or use of a product.

Functions can be of two types:

a) Basic functions-the primary purpose of a product.
b) Secondary functions-other purposes not directly accomplishing the primary purpose but supporting it or resulting from a specific design approach.

Many a time poor value may result in because the functions have not been precisely understood and redundant or unnecessary functions have been imposed.

Value Tests

VE is essentially a questioning attitude looking at the function and costs. L.D. Miles designed a set of value tests to ascertain whether there is a scope for value improvement. If these value tests are honestly applied, there is bound to be room for improvement in most of the products, systems and procedures that we come across. Some of these questions which can work as thought-starters for developing better value alternatives could be as follows:

1 Can the design be changed to eliminate the part?
2 Can you purchase it at lower cost?
3 Does it need all its features?
4 Is there anything better for the intended use?
5 Can a usable part be made by a lower-cost method?
6 Can a standard part be used?
7 Is it made on proper toolings considering the quantities involved?
8 Are there any newly developed materials that can be used?
9 Can two or more parts be combined into one?
10 Can any specifications be changed to effect cost reduction?

Activity A

Choose any product, system or procedure that you are very well conversant with in your day-to-day life and apply the above tests to find out if there is a scope for value improvement in it.

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Identification of Poor Value Areas

By applying the value tests we may come across poor value areas which are responsible for unnecessary costs. These could be in the design of the product, , procurement, handling and storage of materials, production processes, packaging and distribution of the final product. Once we are able to identify poor value areas, we can focus our attention on these so this these unnecessary features can be eliminated

Another way to identify the poor value areas is through, function.cost matrix approach. If a function-is-relatively less important but accounts for a larger percentage *of* product cost then it is a potential area for value improvement. By determining alternative cheaper ways to achieve that function we can reduce the cost and improve value.

In simple terms a 'soundly conducted Value Analysis programme should essentially provide answers to the following questions:

1 What is the item?
2 What does it do?
3 How much does it cost?
4 Can anything else do the same thing?
5 How much does that cost?

14.4 VALUE ENGINEERING JOB PLAN

Value Engineering Process

As mentioned earlier, the major advantage of the approach is that it is a systematic and organised approach that examines all aspects of a problem employing a questioning attitude. Thus a formal approach has to be adopted to go through the VE programme. This formal procedural model of VE process is called VE Job Plan. In the beginning, when Miles proposed VE Job Plan, it was just a modified form of the steps involved in work study. Subsequently, it has been modified and a number of approaches have emerged which are essentially similar. These job plans have various steps and phases with their associated VE techniques at each phase. In one of the job plans the seven steps involved are: (1) preparation, (2) problem selection, (3) information, (4) evaluation, (5) creation, (6) selection and presentation, and (7) implementation and follow up.

In this unit we shall briefly outline the salient features of three different approaches to conduct a VE programme. These are:

a) Job Plan due to Mudge
b) DARSIRI method
c) FAST (Function Analysis System Technique)

Since the Job Plan due to Mudge is a very well recognised approach, we will deal with it in this section. The seven phases of Job Plan are:

i) General phase
ii) Information phase
iii) Function phase
iv) Creation phase
v) Evaluation phase
vi) Investigation phase
vii) Recommendation phase.

Each of these phases comprises or is supported by one or more techniques. There are work-sheets for each phase. The practice of Job Plan and the application of VE techniques should be made on properly selected project. Thus selection of VE project$_s$ is important. Those products should be chosen for the study which are significant in terms of cost reduction potential. In step-by=step application of the Job Plan the project unfolds from the information phase right up to recommendation phase.

The general phase plays vital role throughout and provides a good base for other phases to succeed.

Brief description of each phase together with associated VE techniques are given in the following sub-sections.

General Phase

Throughout the application of the entire Job Plan the techniques of this phase must be diligently applied to create the right environment for Value Engineering job plan to be effective. There are five techniques associated with this phase:

a) **Use good human relations:** It will be seen that considerable personal contact is necessary throughout the Project. The use of good human relations means assistance in place of resistance.

b) **Inspire team work:** This is one of the easiest to talk about, yet one of the hardest to accomplish. It calls for subordinating personal prominence or ego in the interest of the group as a whole.

c) **Work on specifics:** We should avoid generalities and work on specifics. Concrete data and information on specific problems must be secured. Only opinions and hearsay can be expected when talking in generalities.

d) **Overcome roadblocks:** In any organisation a group of dissenters can be found. These individuals knowingly or unknowingly, will use every means at their command to resist change. It is important to be able to recognise roadblocks and then take steps to overcome them. Mudge has in fact compiled an impressive list of

'killer phrases' which people use to kill an idea. It is very crucial to avoid such rnental roadblocks.

e) **Apply Good Business Judgment**: Business decisions and judgments must be based on facts. Poor business decisions and poor judgment become prevalent when personal opinions and feelings take control. To apply good business judgment one must be resourceful, able to think and should be able to pursue new knowledge.

With the general phase as the base of foundation of the job plan, we can enter the second phase-information phase. The techniques included in the second phase, though seemingly simple, incorporate some of the most difficult portions of the approach.

Information Phase

The objective of this phase is to gain an understanding of the project being studied and to obtain all essential facts relating to the project as also to estimate the potential value improvement. This phase comprises of three techniques:

a) Secure facts: Information gathered must be authentic; it is one of the most arduous tasks. The type of information required will be:

i) Technical specifications -dimensions, grades, tolerances, quality, appearance.
ii) Environmental specifications-Seventy, test conditions.
iii) Engineering drawings.
iv) Production sample-actual or model of it.
v) Production data-operations, speeds, rates, output and stock levels.
vi) Cost data-material, labour, overhead-costs.
vii) Work specifications-work place layout, standard times.
viii) Features preferred by Customers.
ix) Development, testing and service records.
x) Quantities involved.
xi) Scrap rates.

b) Determine costs: In order to direct towards those areas promising the greatest return on time and efforts in VE, the complete and accurate costs must be secured.

c) Fix Costs on Specifications and Requirements: By establishing a relationship between the costs and the specifications and requirements, a means is presented by which the latter two can be quantitatively evaluated. Extreme care should be taken during this phase to be sure that true facts are gathered, accurate costs are secured, and these costs are truly related to the specifications and requirements.

Once the techniques of the information phase have been used to secure pertinent data, the function phase of the Job Plan can be used.

Function Phase

The objectives of this phase are to define the functions that a product actually performs and is required to perform as well as to relate these functions to the cost and worth of providing them.

The two techniques of this phase are a major part of the functional approach. When combined with the other techniques of the Job Plan it produces a systematic approach which is different and more productive than any other product improvement or cost reduction approach.

The two techniques of this phase are:

a) Define function: This is one of the most crucial stages in Value Engineering. The method of functional analysis requires functions to be described with only two words, a verb and a noun. By so restricting the functional specifications, clear descriptions of the functions are possible. Concise function descriptions reduce the possibility of a detailed semantic elaboration. They force a rational approach by eliminating superfluous frills. The rules of function description are:

i) Determine user's need for a product or service.
ii) Use only one verb and one noun. The verb should answer the question "What does it do?" The noun should answer "What does it do"? Where possible, noun should be measurable and verb should he action oriented.

iii) Avoid passive or indirect verbs.
iv) Avoid goal-like words or phrases, such as improve, maximise, minimise, optimise, etc.
v) List a large number of two-word pairs and then select the best pair.

Example 1: Some functional definitions are:

	Product	Function
a)	Mirror	Reflect light
b)	Brake	Arrest motion
c)	Clutch	Transfer power
d)	Election tube cover	Shield Tube
e)	Cigarette lighter	Provide ignition
f)	Light bulb	Emit light
g)	Screwdriver	Transfer torque
h)	Coffee cup	Hold Liquid.

b) Evaluate Function Relationship: This technique attempts to determine relative importance of various functions. Through this technique a descending order of importance of the functions is established alongwith the relative value of their importance.

A paired comparison technique to determine the numerical value of various functions is very simple and effective to use. In this, pairs of functions are compared and it is sought to determine which is more important and whether the degree of variation is major, medium or minor. Suppose we are comparing A with B. Then A-3 will mean that A is more important than B and there is a major difference in their importance. B-1 would have meant that B is more important than A but there is a minor difference only. This way a total number of n (n-1)/2 pairs are compared and values entered in a cell if n-functions are to be compared. Then the score is obtained by adding all the numerals following a particular function. The function score divided by the total score gives relative importance of that function.

Function description should be derived for the product and all its components. The evaluation process also helps to find out whether it is a primary (basic) function or a secondary function. The basic function will have the highest score in the above-mentioned process of evaluation. The technique not only establishes the basic and secondary functions but also identifies those functions which are present because of specifications and requirements or present design approach. Generally, a product or component will have only one basic function and a number of secondary functions. If you have more than one basic function, it must be a mere restatement of the other.

Example 2: Here we illustrate the application of function phase on the item. `Door Assembly' of a refrigerator. The two-word definition of each part or component of the door assembly is shown in Table 1 in the form of Functional Analysis Worksheet. The paired comparison of various functions is shown in Table 2. Figure I shows the graphical display of the relative importance of various functions which identify them as basic and secondary. You can also distinguish functions which are there due to present design approach as well as due to specifications and requirements. The basic function of the door assembly emerges as `Provide Security' with the highest score.

Having defined the functions, the next step is to establish the worth of each function. The objective is to determine the poor value functions and to obtain a reference point from which the cost of alternatives can be compared.

Function cost matrix is an effective technique of finding out the relative importance of a function and the percentage cost incurred in attaining that function. If the importance is low and cost is high then it reflects a poor value area.

Example 3: Table 3 shows a Function Cost matrix for a typical product (compass). It describes in two-words the function of a component. Its percentage importance (I) as obtained by paired comparison and percentage cost (C) obtained by allocating cost to attaining that function by that component. The Value index is given by I/C. A low value of I/C ratio shows a poor value area.

Table 1
Functional analysis work sheet

Item: Door Assembly

Qty	Description	Function		Part		Assembly	
		Verb	Noun	Basic	Sec	Basic	Sec
1	Outer Pan	Provide	Support		X		
		Provide	Security	X		X	
		Permit	Rotation		X		
		Provide	Appearance		X		
4	Gusset Plates	Provide	Strength	X			
1	Handle	Provide	Location	X			
	Reinforcement	Provide	Stiffness		X		
1	Centre Stiffner	Provide	Stiffness	X			
1	Lock Assembly	Provide	Fastening	X			
2	Sleeve door	Provide	Location		X		
	Hinge	Provide	Rotation	X			
		Support	Weight		X		
1	Handle	Facilitate	Grip		X		
		Facilitate	Opening	X			
1	Liner	Accommo-date	Articles	X			
		Prevent	Leak		X		
		Provide	Insulation		X		
		Support	Insulation		X		
4	Retainer	Apply	Force	X			
	Strip (Gasket)	Provide	Location		X		
1	Gasket	Provide	Seal	X			
4	Magnetic Strip	Provide	Force	X			
1	Decorative Strip	Provide	Aesthetics	X			
—	Insulating Glass	Prevent	Conduction		X		
	Wool	Provide	Insulation	X			

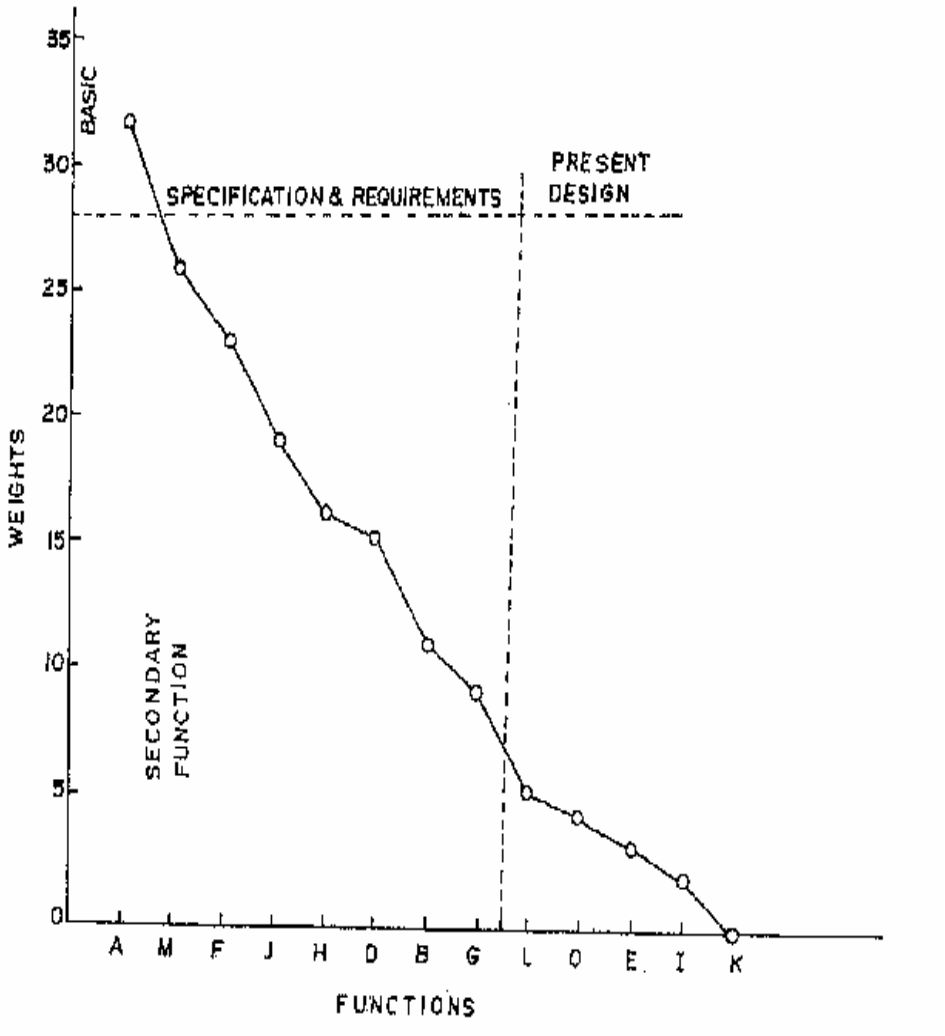

Figure I: Weight Factor vs. Function

Table 2
Numerical evaluation chart for functions

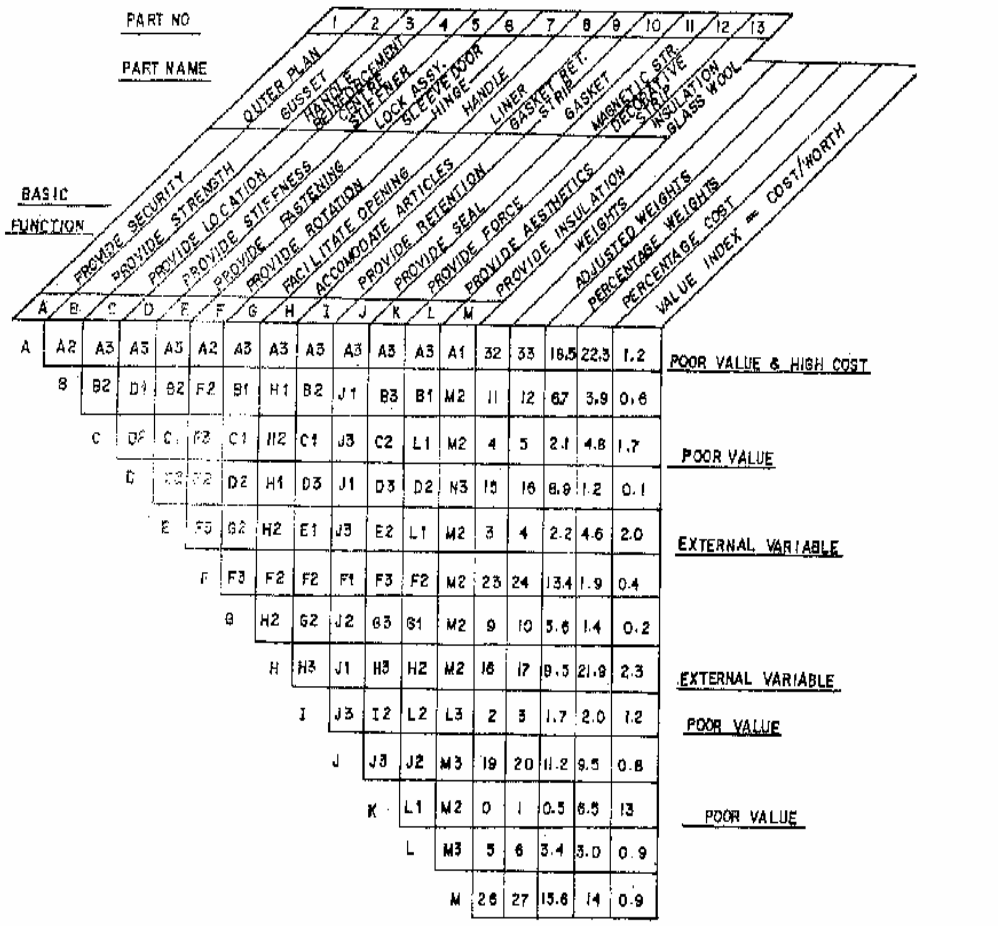

Table 3
Function-cost matrix for a compass

Sr. No.	Component	Function	I (%)	C (%)	Value Index I/C
1	Pencil leg	Contain marker	16	25	0.6
2	Pencil lock	Apply leverage	5	4	1.3
3	Lock rivet	Create fulcrum	1	1	1.0
4	Handle	Access Assembly	0	9	0.0
5	Screw	Connect Components	12	7	1.7
6	Nut	Induce torque	7	3	2.3
7	Washer	Maintain Friction	1	4	0.3
8	Pinleg	Hold Pin	12	20	0.6
9	Pin	Anchor Axis	21	4	5.3
10	Pencil	Deposit graphite	25	23	1.1

Creation Phase

The objective of this phase is to create ideas for value alternatives to accomplish the functions defined in the previous phase. The first step is to try answering the question `What else will do'? This phase requires creativity to be the focal point. Brainstorming is a very effective way of promoting creativity. In brainstorming `free wheeling' is permitted. Two powerful techniques to promote creativity are:

a) Establish positive thinking: Here we divorce the judicial part of the mind from the creative part by insisting that we do not attempt to judge an idea simultaneously when it is being created.

b) **Develop creative ideas:** This is done by cultivating uninhibited thinking and developing a multitude of ideas and approaches for accomplishing the defined functions. The desired thing at this point is a large number of ideas, no matter whether they look ridiculous. A number of check-lists and idea-stimulators could be used for the purpose.

Evaluation Phase

The objective of this phase is to select for further analysis the most promising of the ideas generated during the creative phase and to subject the ideas to a preliminary screening to identify those which satisfy the following criteria:

- Will it work?
- Is it less costly than the present design?
- Is it feasible to implement?

This phase of the Job Plan together with its supporting techniques must be undertaken with both care and diligence, for it is here that the judicial part of the mind is brought into active use. There are four techniques associated with this phase:

a) **Refine and combine ideas:** The ideas must be practicable and to make them so we may have to refine an idea or combine two or more than two ideas.

b) **Establish cost on all ideas:** As an idea or combination of ideas is being refined, an estimated cost should be calculated. What are the potential costs of implementing the idea and what are the resultant savings implied?

c) **Develop function alternatives:** This makes further use of the information developed in the evaluation of functional relationships to mould the individual functional solutions into total solutions.

d) **Evaluate by comparison:** When these rough total solutions and their related estimates of costs have been established they are compared to determine which one will provide the greatest value advantage.

The evaluation of value alternatives may have to be done on multiplicity of attributes-both tangible and intangible. The decision matrix approach can be a very effective way of multi-criteria evaluation. Here each criterion is assigned a relative importance and a normalised value score is allocated to each alternative on each attribute. The total weighted score is obtained for each alternative and the greatest score determines the preferred alternative.

Example 4: For the compass of Example 3 suppose the criteria for evaluation are : Ease of use, Ease of manufacturing, Safety, Quality and Attractiveness with the relative percentage weightage of 15, 30, 20, 25 and 10, respectively. Then the four value alternatives can be compared by using decision-matrix approach as shown in Table 4. As can be seen value alternative A_2 is the best as it gives the greatest total weighted score.

Table 4
Decision-Matrix to evaluate value alternatives for a• compass

		Attributes					
Sr. No.	Value Alternative	Ease of use (15)	Ease of Manuf.(30)	Safety(20)	Quality(25)	Attracti veness (10)	Total Score
1	A_1	100	30	50	70	100	61.50
	A_2	80	100	100	50	50	79.50
	A_3	30	50	70	100	70	61.50
	A_4	50	60	80	50	60	57.00

Investigation Phase

The three techniques of this phase further refine the selected ideas into workable and acceptable solutions providing lower cost methods for performing the desired function. The three techniques are:

a) **Use Company and Industrial Standards**: Within a standard lies tried and proven solution to a problem. We should try to use standards to the extent possible.

b) **Consult Vendors and Specialists:** The vendor may prove to be invaluable source of help in VE programme because he knows more about his product and its potential

capabilities than most of his customers. We may decide to buy an item from the vendor instead of making it within if it is a cheaper and better proposal. Suppliers should be asked for cost-reducing and quality improving ideas. The degree of VE assistance by vendors also varies directly with the types of rewards, such as giving more business to cooperating vendors. Specialists can also contribute by suggesting a better material substitute, for example, by virtue of vast and up-to-date knowledge they may have in their chosen area of specialisation. In VE philosophy the consultation with others is a strength rather than a sign of weakness.

c) Use Specialty Products, Processes and Procedures: These in many cases provide lower-cost way of accomplishing the function; but before being adopted these should be evaluated to ensure lower costs in relation to standard products, processes and procedures.

Recommendation Phase

This is the final phase of the Job Plan in which the finally selected value alternative is recommended for acceptance and implementation. It is vital in the sense that the entire project of conducting VE would succeed only if the recommendation is accepted. Many a time the acceptance of the suggested alternative depends upon the way it is presented to the management. The two techniques associated with this phase are:

a) **Present Facts:** Facts usually speak for themselves.

b) **Motivate Positive Action:** The presentation of accurate, specific and detailed facts and costs will motivate positive action. This technique requires the follow-up to make sure that the action is taken for idea implementation.

The presentation of facts can be either verbal or written in standard format or in combined form. The combined strategy is the best. The final recommendation need not contain all the data but should contain sufficient information to enable decision makers to find the course of action to be taken.

Example 5: We take the same example as `Door Assembly' of a refrigerator which we given for functional analysis phase. After successfully carrying out VE Job Plan, the improved design of the `Door Assembly' was suggested. Figure 2 shows the existing design and the proposed design. Table 5 shows the comparison of costs of the existing design and the proposed design. It shows a saving potential of Rs. 37, 15,200 per year without jeopardising the functions to be accomplished by such an assembly.

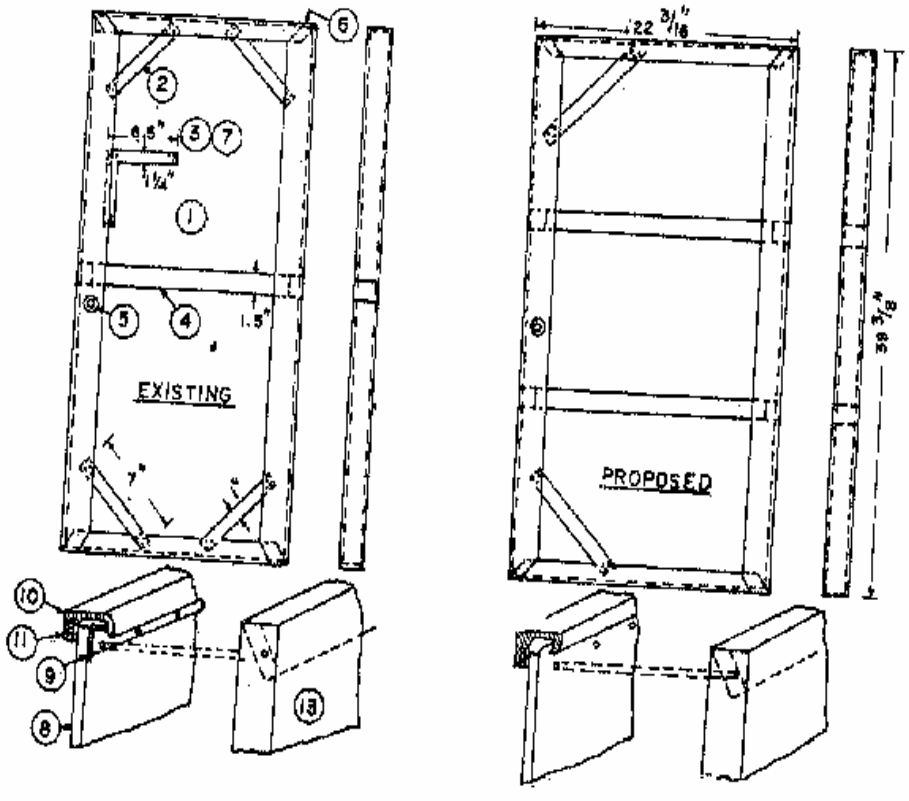

Figure II: Existing and Proposed Door Assembly

Table 5
Summary of savings through VE for the door assembly

Item	Cost per unit (Rs.)		Savings (Rs)		
	Existing	Proposed	Per unit	Per day	Per year
Door Assembly	207.14	194.24	12.90	10.320	37,15,200

Other Variants of Job Plan

Some other variants of the Job Plan described above have also been reported. These are: DARSIRI method and FAST. The FAST is the most powerful of these and will be discussed in detail in the next section. DARSIRI is essentially similar to the Job Plan of Mudge described alone. The seven steps involved are-D (Data Collection), A (Analysis), R (Record of Ideas), S (Speculation), I (Investigation),
R (Recommendation) and I (Implementation).
These are self-explanatory steps and hence need not be elaborated.

14.5 FAST DIAGRAM AS VALUE ENGINEERING TOOL

Basic Methodology of FAST Diagrams

FAST (Functional Analysis System Technique) was developed in 1965 .by Charles W. Bytheway. It visually represents the relationships of functions performed by a product, service or system and identifies where the functions have the greatest impact on costs. It is useful in determining the function inter-relationship in analysing an entire system and gives a better understanding of the interaction of function and cost. FAST is like a network diagram. The steps involved in constructing the FAST diagram are as follows:

a) Prepare a list of all functions of the product using verb and noun technique of functional analysis.
b) Write each function on a small card. Select the card pertaining to Basic Function. Determine the position of the next higher and lower function by answering the following logical questions.
   How is this function accomplished?
   Why is this function performed?
   When is this function performed?

A critical function path may result from the logic sequence of the basic and secondary functions. It is composed of only those functions that must be performed to accomplish the functions. The FAST diagrams are usually bounded on both ends by the scope lines, which delineate the limits of responsibility of the study. For example, if one is value analysing an over-head projector, the FAST diagram will be expanded up to the point where current is conducted to the device. `Generate electricity' is outside the scope of the study.

Illustrative Example

The technique of drawing FAST diagram as applied to Refrigerator Packaging is shown in Figure III. It shows the scope of the study and the entire logical relationship for its basic function `Prevent Damage'. `Prevent Damage' function is to support another function-'Facilitate Transportation` (beyond scope line) and is supported by ‘Prevent Corrosion’ and ‘Prevent Impact’. Similarly, the entire network is completed.

The cost of each part is divided into different headings of functions in the ratio of its estimated contribution to perform this function. Thus total cost apportioned to perform that function is computed and entered in the FAST diagram outside the box describing the function. In Figure III the highest functional cost is Rs. 17 to accomplish the function `Product Corners' in the Packaging. It thus identifies the high cost functions where potential for savings exist. In the proposed packaging, the total `cost could be reduced to Rs. 77.96 per unit as compared to Rs. 87.84 per unit in the existing design, thus giving a saving potential of Rs. 69, 78,240 per annum.

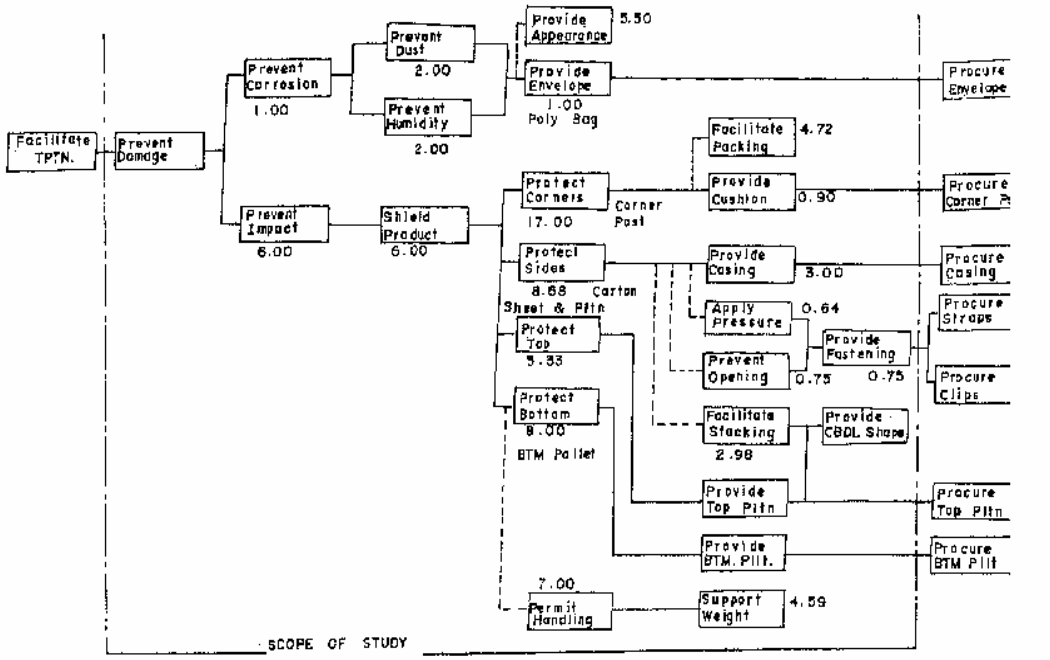

Figure III: Fast Diagram Refrigerator Packaging (Existing)

14.6 SOME CASE STUDIES IN VALUE ENGINEERING

Value engineering has been very extensively applied in product design, systems and procedures and a very large number of case studies have been reported in books and journais`oh Value Engineering. In many of these case studies large amounts of savings have been reported. In Indian industries value engineering applications have been reported from TISCO, Escorts, TELCO, Kelvinator, Railways and other units in public and private sectors. It is also known to have been applied in Indian Army and Navy.

Some very simple case illustrations are as follows:

i) **Problem:** Make design changes to reduce the construction cost in a large garage for a trucking firm.

Function: Protect Trucks

General Explanations and Solutions: Company management had drawn plans to construct a large garage complex for its fleet of trucks. The value Analysis pointed out that trucks were on road on an average of 20 out of 24 hours. What was really needed was a large parking area and a small maintenance building.

ii) **Problem:** Reduce the number of guards by combining entrances to classified areas.
Function: Monitor doors

General Explanations and Solutions: It was difficult to reduce the number of doors to the classified areas. However, it was found that each guard could monitor and control two entrance doors by using CCTV and electric door locks.

iii) **Problem:** Reduce the manufacturing cost of gasoline tanks for the landing aircrafts.

Function: Hold gasoline

General Explanations and Solutions: Initial design was inherently very costly. It was discovered that standard 55 gallon steel drums could be easily modified, coated and used.

iv) **Problems:** Reduce the manufacturing, cost of oil dipstick

Function: Measure Oil

General Explanations and Solutions: It was discovered that standard dipstick used in large numbers could be more economically purchased from outside vendors instead of making.

14.7 BEHAVIOURAL AND ORGANISATIONAL ASPECTS OF VALUE ENGINEERING

Basic foundation of VE is structured around the effective use of people in teams. If team work is not properly harnessed it may not achieve major cost reductions. Some problems and roadblocks that are commonly encountered.in the VE process are:

i) Individuals involved in VE usually have other jobs and are already busy.
ii) Teams may be inherently conservative, non-coherent and may avoid decisions and waste time.
iii) Individual members of the team may have vested interests in resisting changes.

The success of VE study is enhanced if organisational and behavioural aspects are considered early in VE process. Hence the importance of the general phase of the VE Job Plan. Some important factors are;

a) Organising for VE: Organising of VE function itself is very important. There are many alternative ways of doing it and there are many question to be answered. Size, composition, level of participation, leadership are some of the relevant issues. VE may be organised as a team of multidisciplinary areas coordinated by a value engineer/industrial engineer. It may be an independent cell in staff level or it may be visualised as a philosophy-conditioning of mind so that every individual be trained to be value conscious so that it gets reflected in his decisions and attitudes towards problem solving. The right choice is contingent upon various situational parameters.

b) Decision Making: How are decisions to be made in a team? What are the external influences? What are the processes of approval? Are there some relevant issues that must be debated in the early stage of VE process?

14.8 BENEFITS OF VALUE ENGINEERING AND CONCLUDING REMARKS

Value Engineering helps in improving efficiency as well as effectiveness of products, systems and procedures. In general, VE,

i) enables people to pinpoint areas that need attention and improvement.
ii) provides a method of generating ideas and alternatives for possible solution to a problem.
iii) provides a means of evaluating alternatives including intangible factors.
iv) provides a vehicle for dialogue.
v) documents the rationale behind decisions.
vi) materially improves the value of goods and services.

In conclusion.it must be re-emphasised that VE/VA is an extremely powerful methodology for cost reduction and value improvement and is becoming more and more popular. It is applicable to all areas: hardware, products, services, systems or procedures, and in all functional processes: purchasing, designing, producing, packaging physical handling and distribution.

14.9 SUMMARY

Value Engineering/Value Analysis is a systematic and organised effort to identify the functions of a product, system or procedure and to attain that function with minimum cost without jeopardising quality, aesthetics, appearance etc. The Systematic procedure is known as VE Job Plan. Its phases include General Information,

Function, Creation, Evaluation, Investigation and Recommendation. Each phase has a set of techniques associated with it. FAST diagram is another powerful technique for VE. Other important techniques are functional analysis, function-cost matrix, paired comparison and decision matrix. Value Engineering requires a good team spirit and an effective organisation. Benefits of VE in cost reduction and value improvement are tremendous. It is equally applicable to hardware and software projects.

14.10 KEY WORDS

Brainstorming: The process of generating creative ideas in a group by permitting free and uninhibited discussions among the team members.

Decision Matrix: A technique of evaluating finite number of alternatives against a multiplicity of factors.

Esteem Value: The properties, features or attractiveness which create a desire to possess the article.

FAST: Function Analysis System Technique; it looks like a network representation of various basic and secondary functions showing their inter-relationships.

Function: The term used to mean the purpose or use of a product.

Function Analysis: A technique to describe function of a product or system using two words-a verb and a noun.

Function Cost Matrix: A tool for identifying poor value areas by showing percentage importance of a function in a product and percentage cost spent in accomplishing that function.

Job Plan: A systematic procedure consisting of seven phases to carry out a Value Engineering Project.

Mental Roadblocks: Conditions of mind due to beliefs, resistance, fear etc. which retard creativity and idea generation.

Primary (Basic) Function: It is the basic or specific purpose for which the component or assembly was designed.

Paired-Comparison: A technique of determining relative importance of functions in Value Engineering by comparing two functions at a time.

Secondary Function: A function which does not directly contribute to the basic function or is only needed to support the achievement of a primary function playing enabling role.

Scope-lines: Used in FAST diagram to delineate the scope of responsibility VE study.

Unnecessary cost: Also termed as hidden or invisible cost which does not improve the quality, features required by customer or the product utility but only increase the cost; for example, materials handling cost.

Use value: The properties which accomplish a use, work or service. The use value is equal to the value of the functions performed.

Value: A composite of product quality and cost considerations expressed as a ratio of quality to cost.

Value Engineering (Value Analysis): A systematic organised approach to determine the function of a product and system and find least cost ways of achieving it.,

Value Index : Ratio of relative importance of a function to its relative cost.

Vendor: Supplier of materials, products or services who can play an effective role in cost reduction and value improvement.

Worth: Relative importance of a function.

14.11 SELF-ASSESSMENT QUESTIONS/EXERCISES

1 Identify five products in your day-to-day life and determine reasons for poor Value in them.

2 Applying the Function Analysis approach write down the basic functions of the following objects in two words:
   i) Umbrella
   ii) Ash Tray
   iii) Paper Weight
   iv) Wrist Watch
   v) House.

3) Write true or false against the following statements:
   i) Value engineering aims at reducing the cost by compromising on the desired quality.
   ii) Basic functions can be many in a product.
   iii) It is good for creativity if an idea is evaluated immediately after generating it.
   iv) Value Engineering is equally applicable to products, systems, procedures, services.
   v) L.D. Miles developed the FAST.

4 Choose the most appropriate answer from the following:
   a) Value Analysis concepts were developed by:
      i) Arther E. Mudge
      ii) F.W. Taylor
      iii) G:B. Dantzig
      iv) Henry Gantt
      v) Frank Gilbreth.
   b)The basic function of a telephone is to:
      i) transmit message
      ii) provide status
      iii) provide safety
      iv) permit dialogue
      v) allow discussion.
   c)The tie clip as product is:
      i) primarily use value-oriented
      ii) primarily esteem value-oriented
      iii) substitutable by a paper clip.
      iv) not amenable to Value Engineering concepts
      v) too trivial for applying Value Engineering.

5 Suppose the following five attributes are identified to evaluate a value alternative initial cost; functional performance; reliability and maintainability; product appearance; and, dependence on supplier. Use paired comparison approach to determine the relative importance of these attributes.

6 Identify the basic and secondary functions of a typewriter and arrange them in a descending order of importance.

7 Write an essay on how to organise value engineering function in an electronic industry.

8 Why are suppliers sometimes helpful in value analysis programmes? How can they help? Does it violate your concept of good business ethics to involve them in your problems?

9 Critically examine the following statement: "Value Engineering is more of a human relations, team building and motivation programme than anything else".

10 Study the following situation and attempt to answer the questions raised.

Thomas is a purchasing manager of a company making do-it-yourself power tools. The president of the. company entrusted him the task of cost reduction through value analysis.

Thomas organised a display of all bought out parts and sub-assemblies and the fancy Drill-A-Thon, made of castings, stampings and termings to draw the most attention. It had been designed and turned over to a supplier before purchasing became a separate profit centre under the president. In response to his queries to improve the assembly he got the following responses from three visiting salesmen.

The first company said that they would really gain price advantage if plastic instead of metal was accepted. The second company offered to make the product with fewer parts while the third company suggested that the best way was to assemble it within and they would supply parts at rockbottom prices.

Vice President of the Deen Dayal Industries Pvt. Ltd. who are the present suppliers *rang* up Thomas to express his concern in offering the products his company had been supplying for long to others and wondered whether these newcomers could make a better offer. He expressed a desire to be given a chance to reduce cost by trying value analysis. The chief design engineer also ridiculed the idea of going for plastic in place of metals and saw in it a conspiracy to cheapen their merchandise.

Thomas thus faces a conflict of view points. The president has given an ultimatum to reduce cost by at least 5 per cent, and his company's design experts are uneasy about outside interference. Would-be-suppliers are anxious in re-designing Drill-A-Thon to fit their own shops Now:

i) How can Thomas start a sound value analysis programme?

ii) How should he handle the reactions of his present supplier?

In what way can he use the offered help of the would-be-suppliers who can be genuinely helpful?

14.12 FURTHER READINGS

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