VALUE ENGINEERING (20ME2601A)

UNIT I

Introduction: Value engineering (VE) concepts, advantages, applications, problem recognition, and role in productivity, criteria for comparison, element of choice.

Organization: Level of value engineering in the organization, size and skill of VE staff, small plant, VE activity, unique and quantitative evaluation of ideas.

Introduction

Value engineering (VE) concepts:

- 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 jeopardizing their function.
- L.D. Miles defined VE as an organized 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".
- 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.
- VE may be simply perceived 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.
- Value engineering is a systematic, organized approach to providing necessary functions in a project at the lowest cost.
- Value engineering promotes the substitution of materials and methods with less expensive alternatives, without sacrificing functionality.
- It is focused solely on the functions of various components and materials, rather than their physical attributes.
- Value engineering is also called value analysis.
- Value engineering is the review of new or existing products during the design phase to reduce costs and increase functionality to increase the value of the product. The value of an item is defined as the most cost-effective way of producing an item without taking away from its purpose.

OBJECTIVES OF VALUE ENGINEERING

1. To reduce piece cost and total cost as illustrated by the case study below.
2. To improve operational performance.
3. To improve product quality.
4. To reduce the manufacturing costs.
5. To improve customer-supplier relations.
6. Cost avoidance on future programs.
7. To reduce in product variations.

THE CONCEPT OF VALUE

- Value maybe perceived as the ratio of the sum of positive and negative aspects of an object.
- The value of a product will be interpreted in different ways by different customers.
- Its common characteristic is a high level of performance, capability, emotional appeal, style, etc. relative to its cost.
- This can also be expressed as maximizing the function of a product relative to its cost:

Value = (Performance + Capability)/Cost = Function/Cost

- In some cases the value of a product can be increased by increasing its function (performance or capability) and cost as long as the added function increases more than its added cost.
- Functional worth is the lowest cost to provide a given function.
- In value method terms:

Value = Worth / Cost

OR

Value of an item = Performance of its function / Cost

OR

Value = Σ (+) / Σ (-) =Σ (Benefits) / Σ (Costs)

Types of value or classes of value:

The economic value can be broadly divided into six basic types of values.

USE VALUE:

The money spent just to justify the usefulness of product.

EXCHANGE VALUE:

Additional amount paid to guarantee the resale or exchange at any point of time.

Feeling of safety.

ESTEEM VALUE:

To meet a particular satisfaction or ego need.

Does not contribute towards satisfactory performance.

Appearance engineering

Packaging

There are many cases where it is not needed.

COST VALUE:

It is a fact and expense to produce the item or service. o Production cost

PLACE VALUE:

At any given place the product would have a specific value. o A glass of water in a desert.

TIME VALUE:

At only a given time, the value of an item is important. o Umbrella in rainy season.

FUNCTION

It is the natural action performed by the product. •

Anything less than the necessary functional capability is unacceptable •

Anything more than the necessary functional capability is wasteful. •

To achieve optimum value of any product, the functions must be carefully defined. 6.5

Types of Function

➢ Use Function & Aesthetic Function:

Use Function:

o It performs some function.

o It is mostly measurable.

Aesthetic Function:

o It pleases the customer.

o It is mostly non-measurable.

➢ Primary Function & Secondary Function:

Primary Function:

o Basic purpose for which product exists.

Secondary Function:

o It arises out of specific design, chosen to fulfill the primary function.

➢ Higher Order Function & Lower Order Function:

Higher Order Function:

o Reason for satisfy the basic function.

o Required output.

Lower Order Function:

o Means of achieving the basic function.

o Given input.

- For example: Chair
  - ✓ Need statement: The chair is designed to support a maximum of 100 kg weight. Verb is support and noun is weight.
  - Support weight (Primary & Use function)
  - Provide comfort (Secondary function)
  - Enhance appearance (Aesthetic & Secondary function)

Benefits of Value Engineering

• Lowering operating & manufacturing costs
• Improving quality management
• Improving resource efficiency
• Simplifying procedures
• Increasing procedural efficiency
• Lowering staff costs
• Developing value attitudes in staff
• Competing more successfully in marketplace

Advantages

- ✓ Powerful Tool& Scientific Tool
- ✓ Keep management update
- ✓ Use of resources
- ✓ Creative ability
- ✓ Proper atmosphere
- ✓ Import substitution
- ✓ Applicable to all stages

Disadvantages

- X Based on specific scientific theory
- X Rigorous technique
- X Need expert knowledge
- X Time consuming
- X Expensive

FIELDS OF APPLICATION OF VALUE ENGINEERING:

Value engineering uses rational logic and the analysis of function to identify relationships that increase value.

Fields where the raw material is scarce, skilled labour is in shortage or component part are not easily available require Value engineering to get most use out of the available substitutes.

Usually, these lead to reduction in cost, improvement in product or both, which in turns give rise to a better product.

Value engineering is used in most industries where the input is very critical to the product quality such as in manufacturing industry, the raw material should be a proper specification and strength as required but at the same time the cost should not be too high**.**

PROBLEM RECOGNITION:

The problem recognition might be due to:

1. A product being out of stock like Oil, floor, raw materials can lead to a problem
2. Dissatisfaction with the current product or state
3. New needs/wants based on the lifestyle and hierarchy in life
4. Related products/purchases e.g. After buying an expensive phone, people look to buy a case immediately to protect the phone
5. Marketer induced problem recognition which are inactive problems
6. New products and categories e.g. When an iPad was launched, people were working on phones and desktops. After the launch, a new category got created in the market called Tablet PCs.

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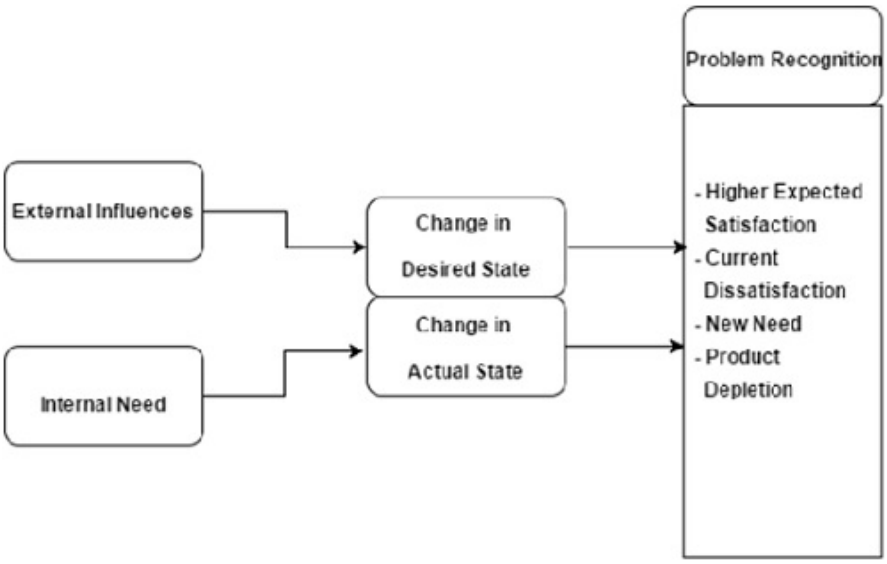

Problem recognition is the initial step applying VE. when a consumer recognizes a need or a want which is not being fulfilled by any of the existing products or services available. Problem recognition is to identify the gap which now has to be filled with a product or a service. It is also defined as a gap between the current state and the desired state from the customer's perspective. Problem recognition is the result of a discrepancy between a desired state and an actual state that is sufficient to arouse and activate the decision process. An actual state is the way an individual perceives his or her feelings and situation to be at the present time.
Problem recognition is followed by information search, evaluation of options.
Types of problem recognition and action required:
Routine Problems – routine problems in which the disparity between the expected state and desired state is expected to develop and require an immediate solution. An example of this type of problem is grocery purchase decisions made by customers. In addition, convenience goods are generally associated with routine problems.
Emergency Problems – emergency problems are unexpected and require an immediate solution, such as a consumer who suffered an automobile accident. Likewise, his car needs a quick and immediate solution to his transportation problem.
Planning Problems – when the problem is expected to occur but doesn't require an immediate solution, it is known as a planning problem. For example, when a consumer expects his car to last only six months and starts engaging himself in car brands, quality, and services discussion with his friends, he starts paying more attention to car advertisement, etc.
Evolving Problems – evolving problems are those which are unexpected and don't require an immediate solution. For example, fashion adoption takes place over a long period for some customers.

ROLE IN PRODUCTIVITY:

- Value engineering is the review of new or existing products during the design phase to reduce costs and increase functionality to increase the value of the product. The value of an item is defined as the most cost-effective way of producing an item without taking away from its purpose.
- Value engineering critically examines the contribution made to the product by each feature of a design. It then looks to deliver the same contribution at lower cost. As the same output is being achieved by uses of laser input resources, the productivity increases due to the Value engineering.
- Value engineering can help improve productivity by reducing waste, rework, and downtime. By improving the quality of products and services, value engineering can also help reduce the need for repairs and replacements.

- VE emphasizes cost reduction and improved product functionality, but also considers factors such as the cost of the manufacturing process, machinery, labour, materials, shipping, maintenance, and disposal and recycling.

VE Vs. VA

BASIS FOR COMPARISON	VALUE ANALYSIS	VALUE ENGINEERING
Meaning	Value Analysis is a cost reduction technique applied to the existing product with the aim of enhancing its worth.	Value Engineering is a technique used before the product gets approval for fabrication.
Nature of Process	Remedial Process	Preventive Process
Applied when	After the product is introduced.	At the design stage
Objective	To get better optimized commercial output.	To get better engineering results.
Worked Out	With the help of knowledge and experience.	With the help of specific technical knowledge.
Ensures	Elimination of unnecessary cost	Prevention of unnecessary cost
Change	May change the existing stage of the product or operation	Changes made by value engineering are implemented at initial stages only.

CRITERIA FOR COMPARISON

Value being a relative rather than an absolute measure, the comparison approach must be used in evaluating functions. The larger and more complicated the object undergoing analysis, the greater the number of comparisons necessary to make the analysis sufficiently comprehensive to establish the best value for each included function. This means analysing a series of basic functions, each discovered by breaking the assembly down into its subunits, components, and parts. In this way the problem becomes perhaps one of comparing the use of one material with that of another, the style of one part with that of an equivalent, the application of one process of manufacture with that of another, and so on. It may be a matter of comparing metal with plastics, screw-machined parts with lathe-machined equivalents, or stamping with spinning to determine how the needed function can be obtained reliably at the lowest cost.

ELEMENT OF CHOICE:

1. New item plans are to be presented
2. Pace of profit from speculation goes down
3. Deals of the item fabricated by the business are diminished
4. Expenses of assembling the items are increasing
5. When the competitors are selling their items at less prices
6. When the purchasers are complaining the organization regarding the function of the item
7. The firm cannot meet the delivery dates guaranteed with the customer
8. When the expenses of gathering useful information is increasing than the benefit from the information.

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Organization: Level of value engineering in the organization

1. Appropriate organization for the best benefit of VE from the view point of overall business
2. From the viewpoint of interrelationships among the men performing the work.
3. From the viewpoint of the men performing the work and the management

SIZE OF VE STAFF

One-man Setup:

- Businesses with $2 million or more of annual sales will start with one or more carefully selected and trained value consultants.
- The selection of personnel for the one-man setup is most important.
- This man must rank high in competence, must have a proven record of high accomplishment, must be respected by his peers and management alike.
- His background must be exceedingly broad.
- Real attention must be given by management to this new work until it becomes understood by, integrated into, and accepted by every phase of the business.

Two-men Setup:

- Two men can provide a much more satisfactory penetration of the necessary knowledge and experience.
- Combined in the two, if the work product oriented, should be skill in (1) engineering ideas, (2) manufacturing methods and processes, and (3) the very extensive field of using vendor and specialty-vendor competence.
- While the two men work together, they do not work as an interlaced team. Rather, they work as consultants to each other on any particular job.
- In every instance, each project or activity is the responsibility of one of the two.
- That individual, in turn, to the right extent and at the right time, consults with the other man on the job.
- One of the two may be the senior man and carry certain responsibility for assigning work to the other.
- Care must be taken, however, that neither of the two works as an assistant to the other but rather that each accepts responsibility for a particular activity in the plant and consults with the other as needed.

Three-men Setup

- Normally and practically, three men constitute the smallest efficient operating unit for wide-range value work.
- It is then usually possible to have the necessary penetration in the three required areas of skill named above.
- The three men again act as individual value consultants, each taking responsibility for particular value work and calling on the others as consultants to improve the degree of accomplishment.
- Again, one man may be a senior member who organizes and assigns work to the others, or else the three may report to one and the same manager who, in that case, must have a real grasp of value work, its problems, and its opportunities, and must be capable of performing the management function skillfully.
- Three men often aid one another during the creative phases of their work studies, and having enough in common, they do not readily become frustrated and discouraged.

Four or More Consultants

- As the business begins to see the benefit of the activity, additional value consultants will be added.
- This will provide more penetration in the three identified areas, and besides, additional abilities will be secured. For example, with groups of four persons or more, an individual who has special abilities in teaching and communicating will be very valuable.

- With four or more individuals assigned to the value work, it will be of definite advantage to have the managerial functions delegated to one of them.
- He, then, will be the one to:
  - ✓ set objectives
  - ✓ establish plans and programs
  - ✓ provide for proper staffing of the group, augmented by provisions for continued development and growth in the individuals' competence
  - ✓ motivate appropriate actions
  - ✓ support each specialist in his work with other segments of the business administer work assignments, schedules, compensation, facilities, etc.

SKILL OF VE STAFF

- Successful accomplishment of work requires logic and experience
- As wider experience gained, the specific qualifications for the value specialist becomes more clear, more tangible, and more reliable.
- For the successful accomplishment of value work, the requirements are logic, experience, and great creativity, plus development of certain mental skills such as ability to:
  - ✓ Make rapid and effective searches
  - ✓ Recall
  - ✓ Sort out useful information from what is not useful
  - ✓ Put together new, different, and useful combinations of ideas, materials, products, and processes to accomplish functions
  - ✓ Promptly select those combinations which are most apt to be good ones

Essential Skills for men engaged in value work

Knowledge: For product work, a practical understanding of the properties of materials and their uses and of manufacturing processes, their potentialities, and their limitations is needed. For service work, the equivalent knowledge in that field is necessary.

Imagination: A good practical creative imagination commonly includes ability to retain extensive amounts of information concerning ideas for approaches and solutions to product problems, types of materials, properties of materials, processes, costs, and so forth, all arranged in a suitable order so that differing combinations may be creatively brought together and examined for applicability to problems at hand.

High Degree of Initiative: In value work, there are no definite beginning and ending points, and specific instructions on how and where to proceed are usually non-existent. Further, this type of work is not well enough comprehended by general management for a rate at which it should be accomplished to be spelled out. For these reasons, it is essential that men in value work have a high degree of initiative, which must include what might be called self- drive, so that work activities will be started and carried through to completion with little if any supervision.

Personality: The work requires a mature, stable personality which is not easily discouraged.

Cooperative Attitude: A desire to work with others and a general knowledge of how to do it are other requirements, since the work is largely an endeavour based on working with others.

Experience: All indications to date suggest that some five years of industrial experience in engineering, in manufacturing, or in special procurement dealing with particular specifications, opportunities, arrangements, and negotiations between buyer and seller (or equivalent experience) is essential. It seems also that actual experience in working with the normal situations that affect the development of value alternatives is required. Without experience along this line, there is a lack of background for efficient and effective search of possible combinations and for presentation of new and good value alternatives.

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Belief in the Importance of Value: Experience has shown that men who have strong belief in the importance of value are much more likely to be sufficiently motivated to develop the initiative, self-drive, and enthusiasm necessary to accomplish their work well. Such strong belief also seems to be an important factor in creating emotional stability in this very frustrating type of work.

An Understanding of the Management and Decision Process: It is also important to have a reasonable comprehension of the management and decision process. For years, up to and including the present, decisions have not always been the best ones, but they are very real and very "controlling." Removing unnecessary costs often means patient, persistent, effective work for improvement in these areas.

VE ACTIVITY

Phase 1	Value Engineering Cell	VEC phase
Phase – 2	Value Engineering Department	VED Phase
Phase - 3	Value Engineering Teams	VET Phase
Phase - 4	Value Engineering Circles	VEnCi Phase
Phase - 5	Value Engineering Culture	VEnCul Phase

Value Engineering Cell (VEC)

It is a centralized cell under the Management Services function. It comprises 2 to 4 members. This cell organizes Training Programmes and appreciation courses for the executives and middle level management.

It is treated as routine activity under training departments of the organization. Apart from attending training programmes the members normally do not contribute anything concrete. However, this cell definitely helps in generating an awareness of the technique in the employees. It has been seen that it does create an additional interest in the participants. The urge to do something generated, and few of the enthusiastic members do start spending more time to know more about the technique and its application.

Value Engineering Department (VED)

A centralized function established more like any other function. This is headed by a full time Manager and supporting Engineers and Value Analysts. A target performance is established and the department is expected to fulfill the target by undertaking various studies.

It operates more like a staff function and not as a line function. In most cases the acceptability of VED by the users is of a low order, because it is looked at either as an unavoidable evil or as a spying or auditing activity. There is generally a resistance from the designers and manufactures. VED is normally a step further of VEC, and the fact that a particular organization has a VED does indicate the realization of the management and the need for VAVE. If organizational backing is provided, VED will give much better and more concrete results than the VEC approach.

Value Engineering Teams (VET)

In large size organizations there can be Value Engineering teams in each of the product groups or departments. Each of the groups can be exposed to a detailed application-oriented training programme. This group normally can comprise the designers; manufacturing, and materials functions.

The acceptability of this team and its work is of a much higher degree because of the fact that they are considered to be inside people are known to the sections/departments. As quite a few members are from design or R&D, their suggestions are quickly accepted and implemented.

Value Engineering Circles (VEnC)

Through the VEnC activities and by exposing all the employees to the VAVE programmes and through use of audiovisual aids, a mass recognition can be established. This would result into everybody taking care of the optimum VALUE in his sphere of activities.

Value Engineering Culture (VEnCul)

The ultimate can be achieved through this approach. Once an organization has developed this culture it would automatically take care of the new entrants thinking process and this a full-fledged VALUE culture can be established.

UNIQUE AND QUANTITATIVE EVALUATION OF IDEAS

As value analysis and engineering progresses it has become clear that the original method of evaluating ideas by using the good/bad T chart has serious limitations. disadvantage of the simple evaluation system is that at a value analysis and engineering seminar the ideas that are not developed are lost, and it often happens that a team has not enough knowledge of company policy to choose the optimum solution, which may not always be the lowest-cost solution. The idea of matrix analysis is has been used before for decision making. It has the advantage that numerical scores can be worked out, with due weight factors, thus providing a figure of merit for each possible decision.

It was found that users generally considered three or four functions essential and gave them equal weight and then degraded other functions out of all proportion to their importance. Various modifications were tried until a method was found that is very satisfactory in practice. The modified matrix is set up in the following way. The first step is to write down all the functions and characteristics that must be satisfied. These are put in a positive form; e.g., for an electric motor one writes down "low noise" as being desirable not "high noise" as being undesirable. It is possible to write the latter and then give it a negative sign in the evaluation process, but it has been found that this leads to some confusion and using the positive form throughout is better. The functions and characteristics must now be arranged in order of importance. Often this can be done by inspection. If not, a preliminary scale matrix is used to sort out the order of importance of each function. This checks against all the others in turn. The process is simple. On a matrix sheet similar to that shown in Figure 17-11 all the functions and characteristics are written down the left-hand side in random order and numbered A to Z. Across the top of the matrix the same letters are also written. A diagonal is drawn across the dead squares where a function is compared with itself. Starting with function A, go to the second square in the top row and ask the question, "Is function A more important than function B?" If so, fill in 1 in this square; if not, fill in 0. At the same time fill in the opposite sign in the second square down, which is the complementary square and shows that function B is less or more important than function A. Going on step by step, the matrix is filled in. Then sum the numbers across the matrix line by line and write the totals in the extreme right-hand column. The function with the highest score is the most important; the rest are graded accordingly. The

one with a score of zero comes last and is the least important. If the scores are not all different, a mistake in logic has been made somewhere; this provides a check on the use of the system.
Having put the functions and characteristics into order, the main matrix can be started. This is written on a prepared sheet. The functions are written in their correct order across the top, with the most important function at the right-hand side and the functions numbered from 1 to n from left to right in the row marked "Function Rank Number." Below this is another row, marked "Function Rating Number (+) ." This enables a weighting differential to be applied to the functions while pre serving their overall order. Weighting is already built in by the rank number, so that the most important function has the highest number, and so on downward. But often a device may have, say, seven functions of which four are very important and the other three, like "looks good," may be much less important. The function rating number enhances the importance of the really significant functions by suitably degrading the importance of the minor functions. The rules of the game are that the function rating number may be less than or equal to but may never exceed the rank number, and so positive weighting is applied automatically. The function rating number also allows two or more functions to be given equal weight where their difference of importance is marginal.

FUNCTION	1	2	3	4	5	6	7	8	9	RATING
1. DISTRIBUTE AIR	X	1	1	1	1	1	1	1	1	9
2. CONTROL FLOW	0	X	0	1	1	1	1	1	1	7
3. DIRECT AIR	0	1	X	1	1	1	1	1	1	8
4. RESIST HEAT	0	0	0	X	1	1	1	1	1	6
5. RESIST CORROSION	0	0	0	0	X	1	1	1	1	5
6. LOOK GOOD	0	0	0	0	0	X	1	1	1	4
7. RESIST DAMAGE	0	0	0	0	0	0	X	1	1	3
8. EASY TO ASSEMBLE	0	0	0	0	0	0	0	X	1	2
9. PROVIDE RIGIDITY	0	0	0	0	0	0	0	0	X	1

Function rating grid.

Next, examine each idea on the basis of how well it satisfies each and every function or characteristic listed across the top. These satisfaction factors (s) scored 0 to 10 are filled in under each function. If any s factor is low, creative ability can be used to try and improve it, but remember that this may well alter the cost, which must be modified appropriately. In this way the ideas are under protracted scrutiny on both performance and a cost basis. If any s factor is zero and cannot be raised, the idea is rejected forthwith as being unworkable because it fails to satisfy one function and no further time is spent on it. When all the figures have been filled in, s x + is worked out for all functions and summed across for each idea; it is filled in on the right-hand side under Z+s. This gives a numerical value for the performance of each idea, duly weighted for the importance of each function or characteristic and alongside an estimated cost. From the last two columns, an intelligent appraisal of each idea can easily be made. If the problem is performance at any price, the idea with the largest performance score can be selected. Any idea that has a lower score and higher price than another idea can be jettisoned. Then appraisal can be made on the basis of the market. It could be the supply of Christ mas novelties, where price is more important than performance. In this case, the lowest cost idea is taken, providing that no s factor is zero. On the other hand, if the target is a medium-quality market, one can select the idea that is the best compromise between performance and price. The matrix that has been described is a typical value analysis and engineering exercise on a product or part of a product. But it is equally valid for any management decision once the

functions and characteristics have been established. It is obvious that performance is not the only criterion that can be applied. A second matrix might be filled in, after a value analysis and engineering session attended by designers and production men, by mar keting, using a new set of s factors on the basis of marketing. A third matrix can be prepared on the basis of quality and reliability, and so on, as required. Then an intelligent management decision can be reached to give an optimum answer to several mutually conflicting needs.

MATRIX EVALUATION CHART

Project: MULTIDIRECTIONAL AIR PROJECTOR
Criterion: PERFORMANCE
Date: 4-30

	FUNCTION										
	K. PROVIDE FLEXIBILITY	J. EASY ASSEMBLY	G. RESIST DAMAGE	F. LOOK GOOD	E. RESIST CORROSION	D. RESIST HEAT	C. CONTROL FLOW	B. DIRECT AIR	A. DISTRIBUTE AIR		
Function Rank No.(n)	1	2	3	4	5	6	7	8	9		
Function Rating No.(ϕ)	1	1	2	4	5	6	7	8	9		
IDEA	SATISFACTION FACTOR(s)									Σϕs	EST. COST
a. ORIGINAL PRODUCT PARTS NUMBER	10	7	3	9	8	9	6	8	10	349	$55
b.											
c. ELIMINATE PARTS X & Y	10	8	4	10	8	9	6	8	10	356	$47
d. MANUFACTURE FROM PLASTIC-COATED OR PRE-PRINTED MATERIAL	10	8	4	10	8	9	6	8	10	356	NOT PRACTICAL
e. BUILD IN LOUVRES TO HEAD	10	10	4	6	8	9	6	7	10	334	NO SAVING
f. RIVET LOUVRES IN DUCT INSTEAD OF SCREW	10	10	4	10	8	9	6	8	10	358	$54
g. MANUFACTURE IN GALVANITE MATL	10	8	8	5	9	9	6	8	10	349	$42
h. PLASTIC GRILLE	10	8	9	10	10	9	6	8	10	376	NO SAVING
i. SET UP INTERIOR PAINTING FACILITY	10	8	7	10	8	9	6	8	10	362	NEEDS INVESTIGATING
k. DESIGN A SINGLE DOUBLE HEAD	10	10	7	10	8	9	7	9	10	379	$43
l. UNIDIRECTIONAL											$34
m.											

A particular feature of the matrix is that a team can prepare one during a value analysis and engineering session, and this can later by analysed by, for example, a company executive who has before him all the ideas that were generated, costed, and rated. A lot of the sting can be taken out of the summation of the product of c$ and s by using a desk calculating machine on which the products are calculated without zeroing the total so that the final total is Σφ x s.