



YILDIZ TECHNICAL UNIVERSITY
CONSTRUCTION MANAGEMENT DIVISION

Value Management in Civil Engineering

INTRODUCTION

With the reduction of the resources in the world, the projects are tried to be constructed with the limited resources in the most efficient ways.

The problems confronted in the business world are increasing. The companies are trying new methods in order to overcome the increasing problems and achieve advantages over the other companies.

Some of these methods based on the projects are short term, on the other hand some of them are becoming more important.

INTRODUCTION

In contemporary economical situations, the cost control should be started with the inception of designing stage. And it should be done throughout the construction of the project.

The changes made in the design during the construction stage can lead to the increase in the cost and duration of the project.

Therefore, the projects should be evaluated carefully in the design stage, and all available alternatives should be considered in order to capture the optimum cost.

INTRODUCTION

The probability of awarding a contract of a construction company is high when they can give the lowest bid by minimizing their costs by using the resources in the most effective ways.

The only factor which affects the contractor selection is not the lowest bid. The value of the project should be the highest one. The value has different meanings for different stakeholders of the projects, such as client, contractor, user and designer.

The contractor wants to minimize the cost of the project to maximize their profit. The client wants to earn maximum revenue from the product. The user wants the maximum functionality of the product and the designer wants the most aesthetic product.

INTRODUCTION

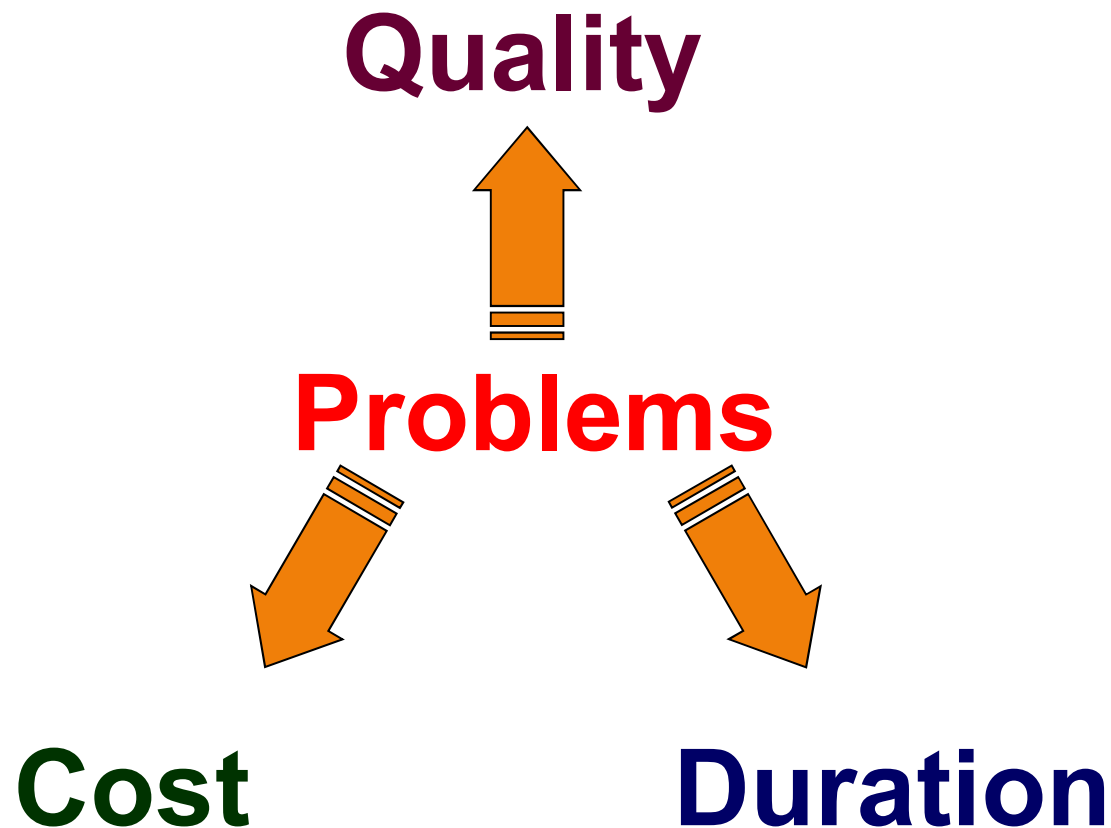
When the term value is considered, firstly we think the price which is the monetary meaning of value. However, the price is not the exact meaning of the value term. In addition, there is no direct relationship between the price and value.

The value term can be considered as the measurement of the willingness of a person to buy or sell a product.

Value = **Cost** + *the price which the customer is willing to pay*

Introduction

In the contemporary construction sector, there are three problems which the companies confront with;



Introduction

The projects are desired to be constructed in the shortest duration, within the minimum cost, and in the best quality.

The quality functions, such as sturdy, usability, continuity, constructability, image, functionality and aesthetics, should be provided within the expected cost and duration.

Since the construction process consists of many elements and long duration, there are many risk factors.

The traditional construction cost control and planning techniques can decrease the cost of the construction with decreasing the quality of the project which leads to dissatisfaction of the client.

Introduction

There are many methods to overcome these problems.

Value management is based on the productivity.

Value management, is trying to organize all elements of the construction in order to increase its value.

The value of a construction can be increased by eliminating all unnecessary costs and providing the purposes of all stakeholders in the optimum level.

Introduction

In order to satisfy this, the required functions should be determined at the beginning of the project.

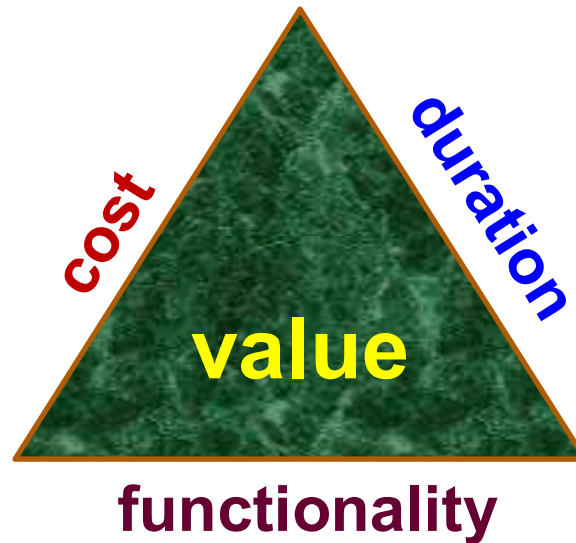
We should be aware that the elimination of unnecessary costs does not mean the decreasing the quality, safety, customer satisfaction and attractiveness of the product.

The aim is determination of a new method to increase the value of the product.

Introduction

The most important components in increasing the value of a product are;

cost - **functionality** - **duration**



(Functionality: The quality of material, design and system, easiness in operation and maintenance, their costs, energy efficiency and environmental adaptation)

All techniques used to increase the value by using all variables in the most effective ways are considered under value management.

Introduction

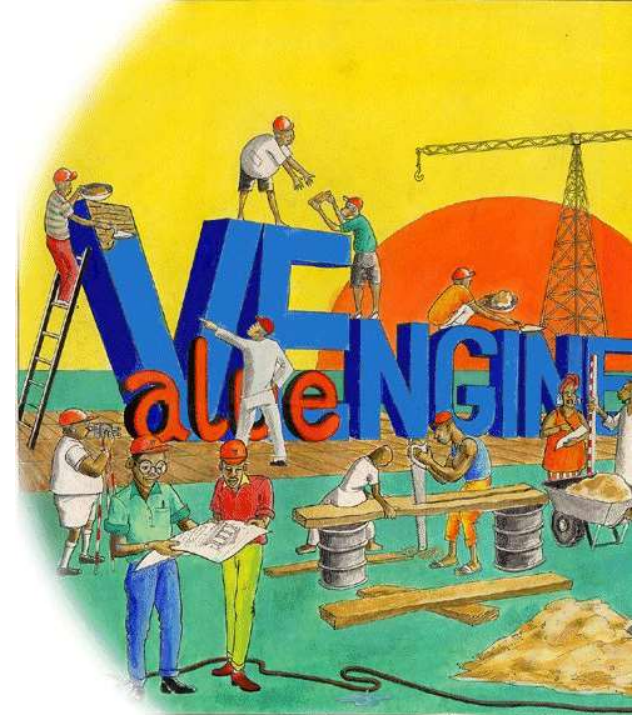
Value management is the combination of the processes performed in three stages of the project.

Value engineering, is a technique performed at the second stage of the value management, namely design-bid-construction.

Value management		
Value plan	Value engineering	Value analysis
Planning	Design-bid-construction	Post-construction

Definition of value engineering

Value engineering is the focus on improving value in the design and construction stages of the 'technical project'. This is the manner in which the business project is translated into the requirement for a built facility through design and construction.



Definition of value engineering

Value engineering is more than just a good engineering technique and routine inspection. Value engineering is the answer of what else can be done.

The value engineering is not just an application about decreasing the cost of the product.

Value engineering, should not only satisfy the benefits of the contractor, but also it should satisfy the benefits of the client.

Definition of value engineering

The advantages provided by applying value engineering:

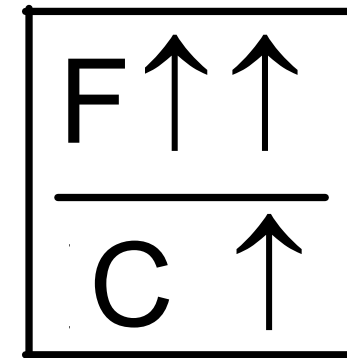
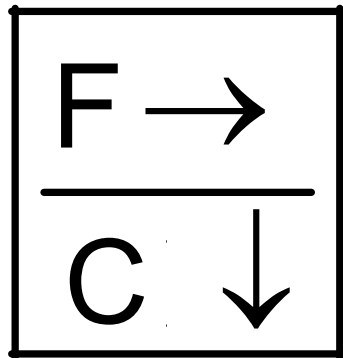
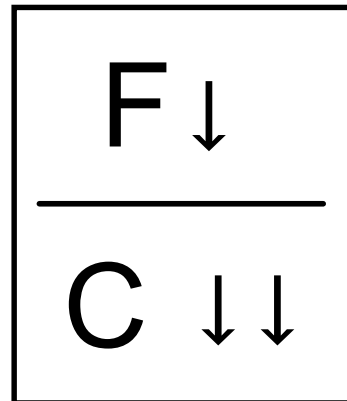
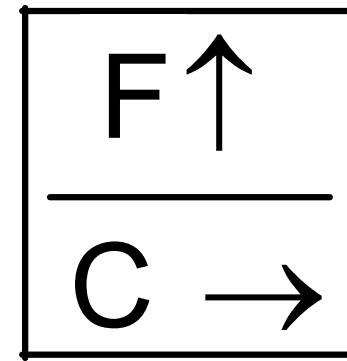
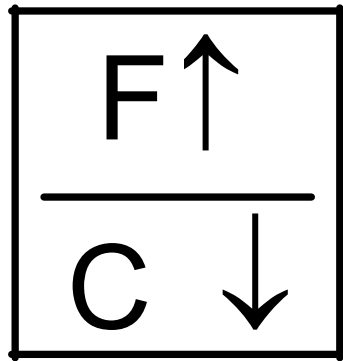
- Decrease the cost
- Save the required time
- Increase the quality
- Isolation of the design defectiveness

Definition of value engineering

- $Value = \frac{Functionality}{Cost}$

Definition of value engineering

The methods used to increase value;



Philosophy of value engineering

The properties of value engineering are:

1. *Systematic study:*

The methods and their orders are certain. They are performed in a system called as work plan.

Philosophy of value engineering

2. *Many experts areas are performed in coordination:*

In traditional methods, when the experts are making decisions related to their areas, they do not know how they will affect other areas. It is important that having knowledge about other experts' studies and directing all of them into a specific purpose to increase the value.

Philosophy of value engineering

3. Consider function term with function analyses :

The design is developed by searching answers for 'which material can be used instead of this material' or 'which material should be used in producing of this element' in traditional methods.

In function analysis, 'why this element is used' and 'what the real function of this element is' are answered in order to determine the 'main function`.

Philosophy of value engineering

For example, when the function of a rat trap is examined, in traditional cost control methods, ‘how the rat trap is designed to increase the number of rats captured by the trap’ is determined.

The function of the rat trap is considered as ‘capturing rats’. For identifying the main function, ‘why’ question is asked. It is answered as ‘decreasing the number of the rats’.

The only method of decreasing the number of the rats can be different than using the rat traps. The other methods can be having a cat, using rat poison or taking environmental precautions in order to prevent coming of rats. **By asking why question, main solutions about the function problems of the project can be developed.**

Philosophy of value engineering

4. Examination of functions in the value perspective:

Function value and function cost are calculated and compared to calculate the **value index** of a product.

Philosophy of value engineering

5. The total cost is considered in the perspective of initial cost and operation cost:

Operation costs, such as operation, maintenance, replacement, and personnel, which form the 60% of total costs, therefore operation costs play an important role in decrease the costs and increase the value.

Since the selection of systems and elements affect the initial cost, the value management considers the total cost rather than one of parts of the total cost.

Philosophy of value engineering

6. Early start-up gives the best result:

In this early start up, the questions related to the future of the project should be asked. The most important ones of these questions are:

“At the beginning, what should be done in order to achieve a low cost construction, product or process?”

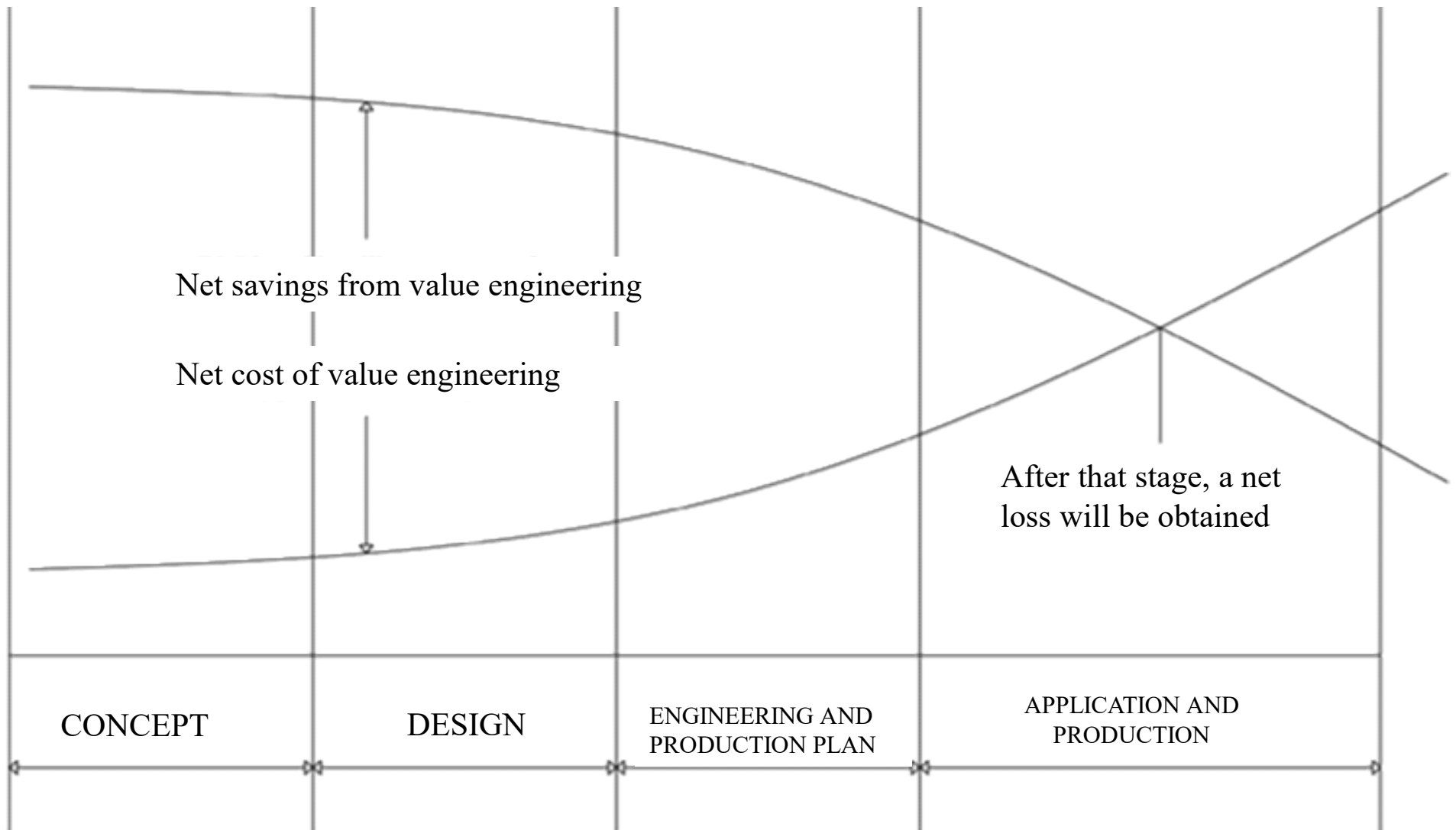
The effectiveness of value engineering depends on application of creative techniques on time.

Value engineering is not just a suggestion program or routine application;

It is a system which applies independent project analyses.

Value engineering, provides the determination of the unnecessary elements or the potential savings based on cost analyses and development of alternative applications.

Philosophy of value engineering



The potential saving diagram of value engineering

Philosophy of value engineering

7. Focus on the most appropriate targets:

The important part of value engineering is focusing on correct targets by using correct methods.

Instead of focusing on an elements which affects the total cost of the project slightly, it focuses on the specific activities which affect the cost of the project heavily.

Vilfredo Pareto says “80% of all global wealth is owned by the top 20% of the population”. This is called as 80/20 Rule and it can be applied to almost anything, from the science of management to the physical world. This principle also affects the development of the philosophy of the value engineering.

Philosophy of value engineering

7. Focus on the most appropriate targets:

When the Pareto's wealth distribution principle is applied to the value engineering, 20% of all components of the project affect the 80% of total cost of the project.

Once these components of the project are identified, they become the principle components of function analyses, since they have the highest potential in making cost savings.

Philosophy of value engineering

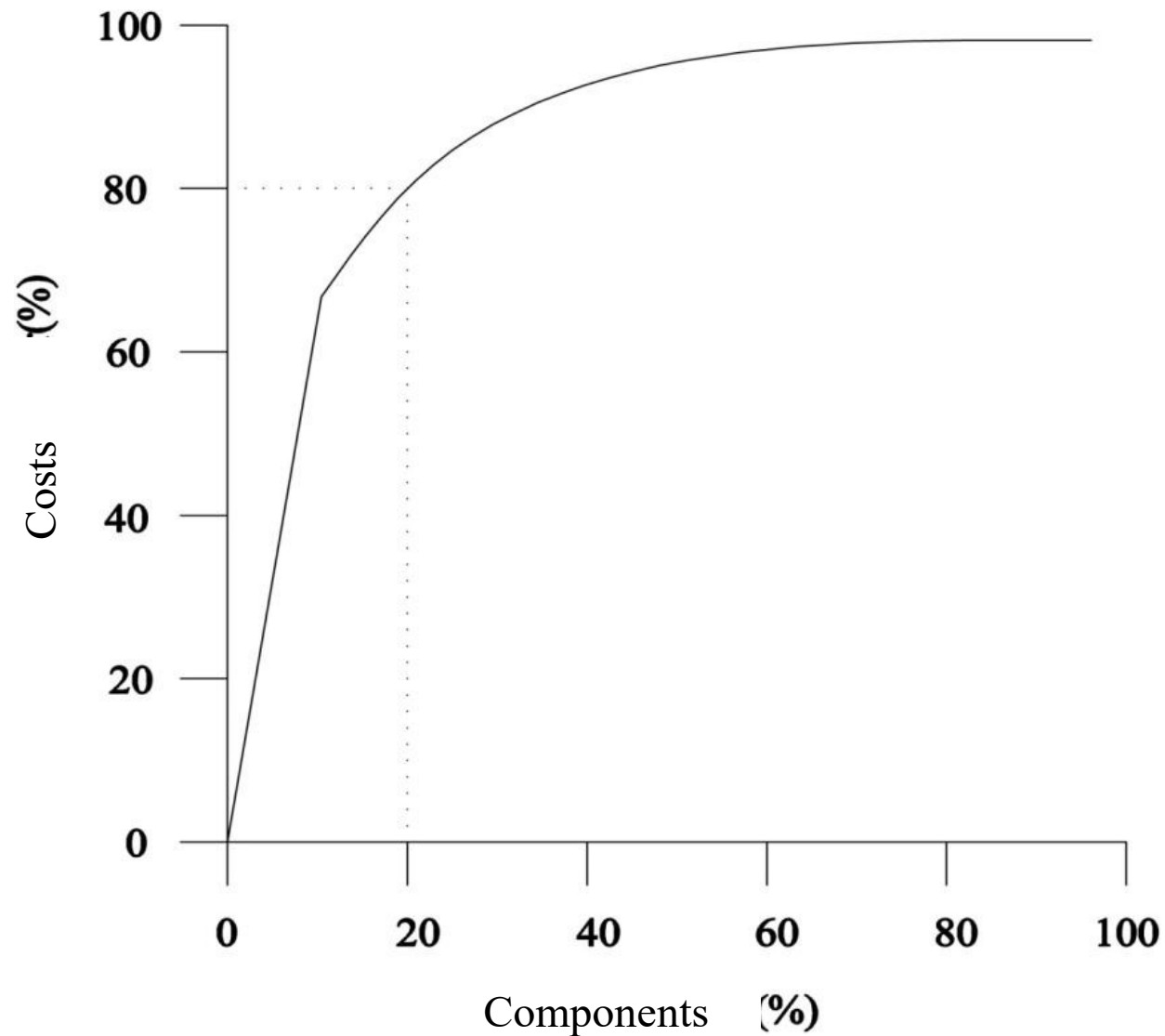
7. Focus on the most appropriate targets:

According to these findings, the concept of “focus on the most appropriate targets” emerges.

In other words, when the critical points of the project is identified, the modifications made on these points can be more effective than the rest of the project.

Since, these critical points are important on both cost and progress of the project.

Philosophy of value engineering

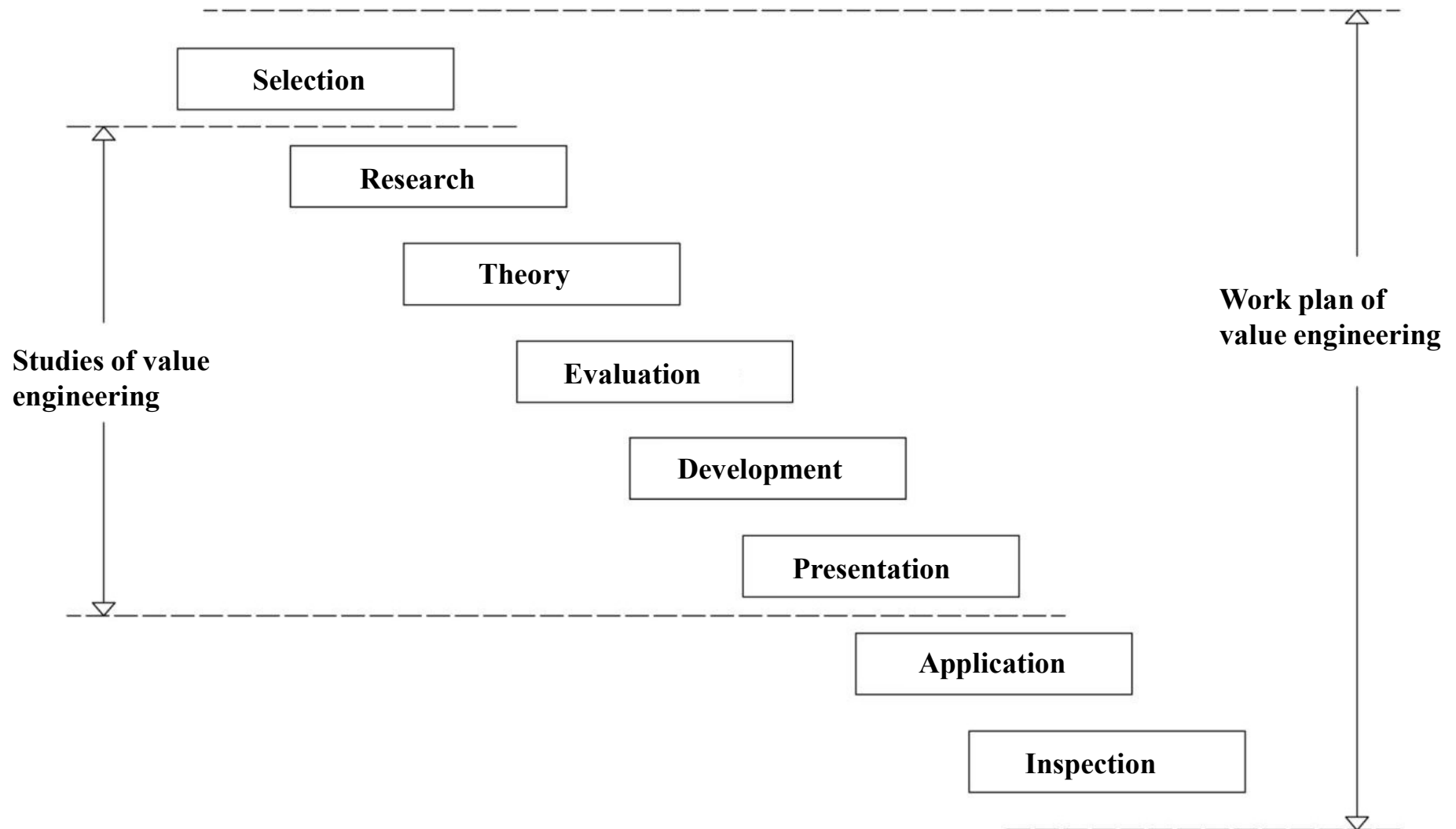


Pareto's wealth distribution law

Stages in Value engineering

Stages of value engineering(Work Plan)

Value engineering is a systematic process which consists of 8 stages. Each of these stages are names as the techniques of value engineering.



Stages in Value engineering

1. Selection stage

- The determination of work area where value engineering is applied.
- Alignment of costs (Pareto Principle)
- Effects of program
- Probability of acceptance
- Selection of value engineering team

Stages in Value engineering

2. Research stage

- Collection of data
- Identification of functions of system and components
- Formation of FAST diagram
- Calculation of cost of project life



Stages in Value engineering

2. Research stage

Formation of FAST Diagram

Function Analysis Systems Technique – FAST is developed by Charles Bytheway in 1960s for performing function analyses.

Fast diagrams are the approaches used to combine functions of a system. This approach shows the duration of the validity of a function and the location of the component, where it places, in the project. By using the diagram, the components which are affected from this function are determined easily when a problem related to this function occurs. Also, this diagram shows which components affect this function.

Stages in Value engineering

2. Research Stage

Formation of FAST diagram

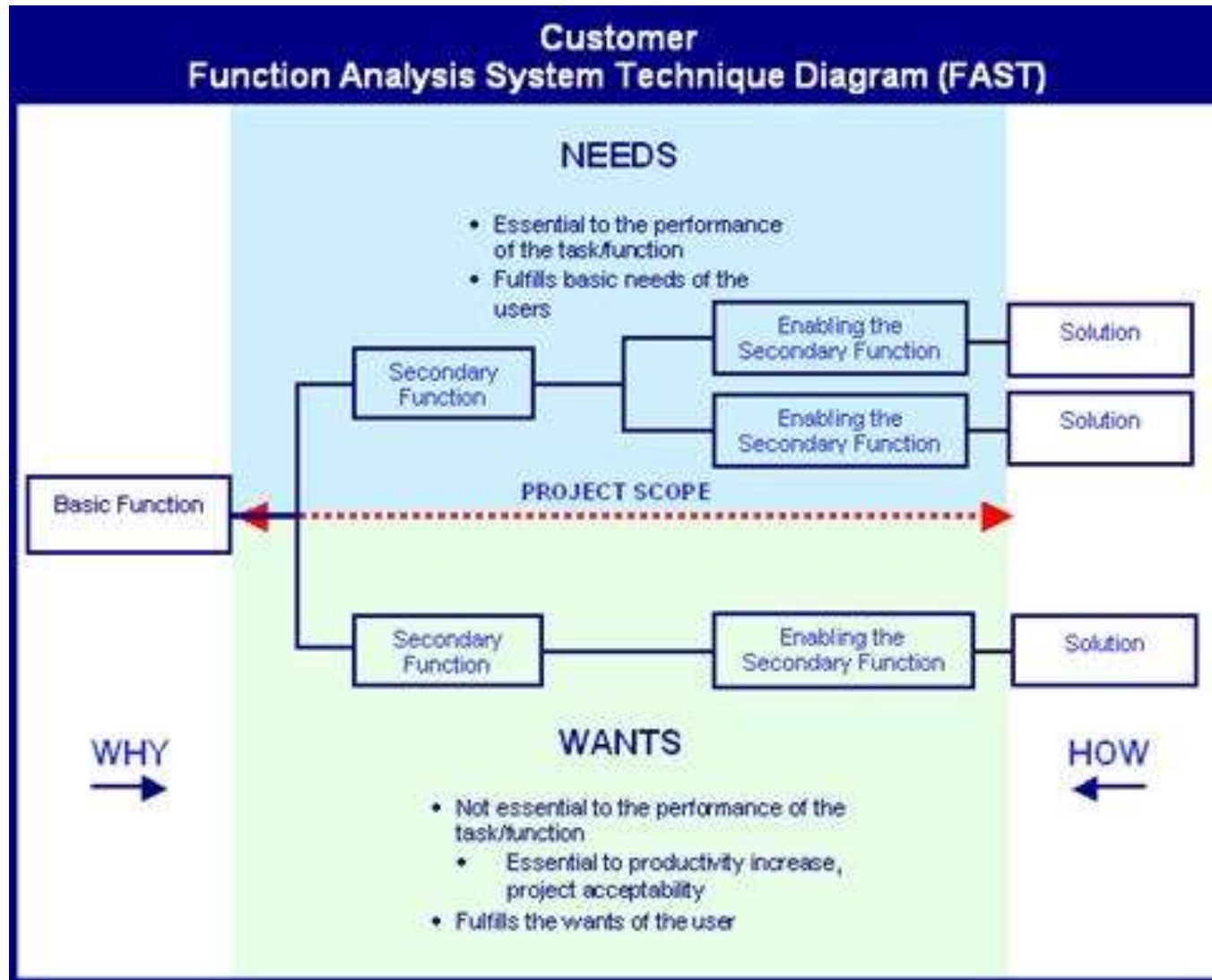
In developing of FAST diagram, three questions are tried to be identified:

- What is the problem or opportunity, what are we discussing at this point?
- Why is this problem or opportunity?
- Why is the solution required?

Function analysis tables consist of function's verb and noun, type of function (main, secondary, technical), value, cost.

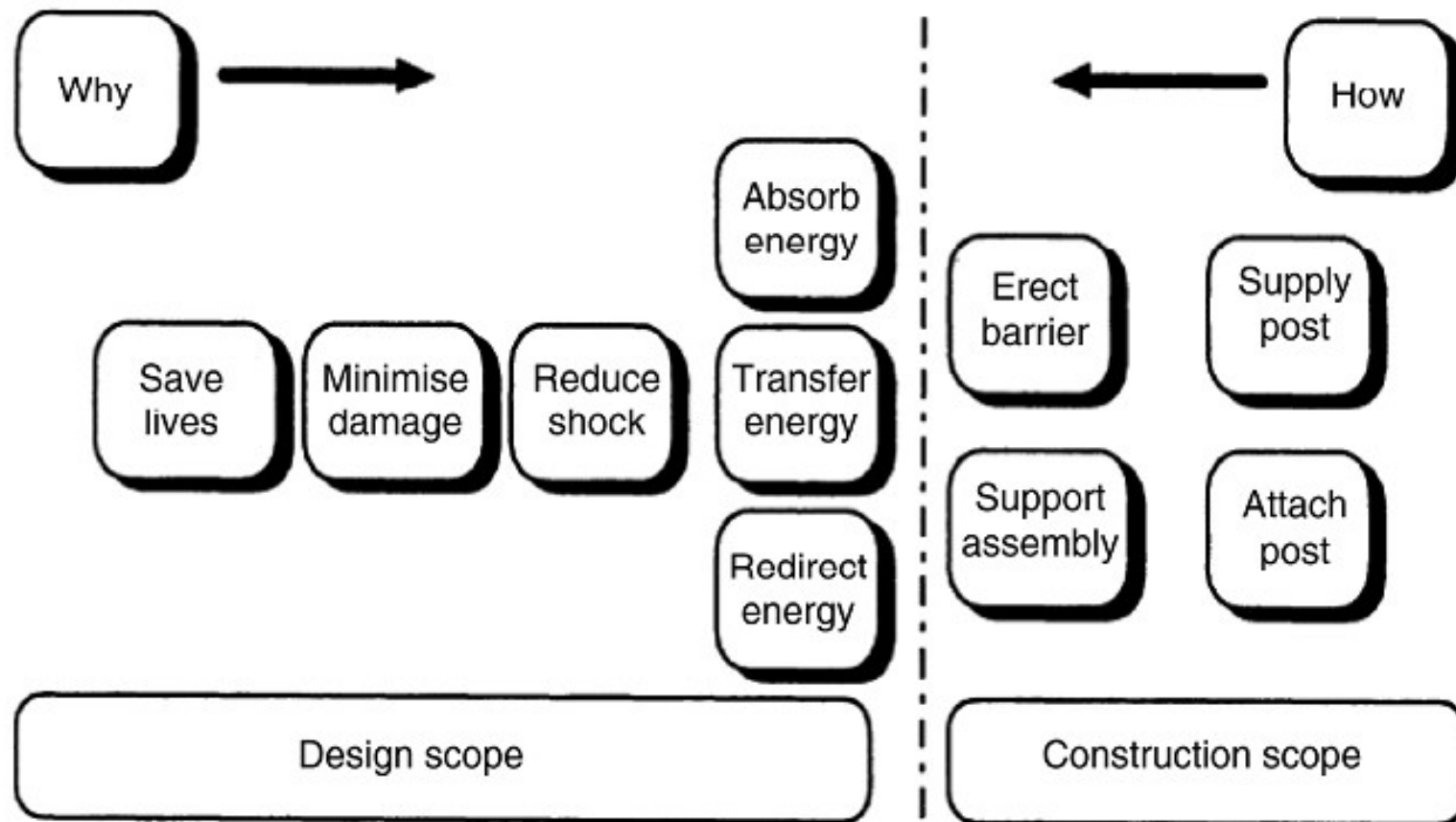
By exploiting these tables, the prior areas are determined by calculating value indexes.

Stages in Value engineering



FAST diagram

Stages in Value engineering



Stages in Value engineering

2. Research Stage

Formation of FAST diagram

Strong aspects of FAST diagram;

- × All relationships and connections between all functions are shown explicitly.
- × The validity of a function throughout the project can be observed easily.
- × It facilitates the understanding and solving the problems.

Stages in Value engineering

3. Theory stage

In this stage, the alternatives which are evaluated are developed.



The brainstorming is considered as the best technique to develop the alternatives. In this technique, the value management team examine each functions and record all alternatives to fulfill these functions.

The target is developing as many alternatives as possible. Free thinking is important in development of alternatives. In this stage, it is not allowed to criticize the developed alternatives.

Stages in Value engineering

4. Evaluation stage











Project life cost and alternatives so on are evaluated in the **technical and rational perspective** at this stage. The alternatives developed at the theory stage and the conclusions of these alternatives are evaluated at this stage.



Stages in Value engineering

4. Evaluation stage

The key questions are used in selection of alternatives and common ideas:

-  How does the selected idea work?
-  Can the selected be applied in the work process?
-  What is the cost of the idea?
-  Is this an idea to fulfill the basic purpose?
-  Which idea provides the lowest cost?
-  Can the idea be modified?
-  Can the idea be combined with another idea
-  What is the probability of application of the idea?
-  Can it fulfill the customer requirements?
-  How much savings does it provide to the project?

Stages in Value engineering

5. Development stage

This is the stage where the selected idea is developed in the desired and applicable aspect by supporting it with the **technical and economical data**. Especially, the **probable design and cost estimation** are very important steps in acceptability and final application of the project. The following procedure should be applied;



The resources are identified for additional knowledge,



Technical feasibility of the selected alternatives are performed,



The advices of the experienced experts are captured,



The economical feasibility study is performed for selected alternatives,



The application plan is developed by identifying the detailed change advices and available data.

Stages in Value engineering

6. Presentation stage

The purpose of the presentation stage is facilitating the decision making for decision makers by presenting the alternatives explicitly and unbiasedly. The presentation should be supported with the written proposal summarizing all work.



Stages in Value Engineering

7. Application stage



In this stage, the proposal offered by the value engineers are achieved according to the developed plan with the support of all parties, especially administration units.

The application of value engineering is clear and production is started. The method is turned into a procedure, and the value engineering is performed throughout the project, since the changes and replacements in the value engineering can be made.

Therefore, the value engineering is a continuous process from the beginning of the project to the end of the project.

Stages in Value Engineering

8. Inspection stage

The purpose of inspection stage is to control the project and documentation of these processes to achieve the desired outcomes from the project.

Throughout the inspection stage, authorized personnel inspect the project, develop the captured knowledge, and prepare the value management final report to present the authorities.

Inspection is the basic requirements of the successful application of value management.

The training required for value engineering

The training required for value engineering:



- **Value analysis**
- **Function analysis**
- **Cost estimation**

The training required for value engineering

Value analysis

According to the general definition, determine which alternatives lead to better solution and obtain the required function at the lowest cost.



The training required for value engineering

Value analysis

In value analyses; the following questions are answered

- ➡ What is the function of the alternative (product, method, service)?
- ➡ Is this function necessary?
- ➡ What is the cost of alternative?
- ➡ What are other alternatives that can fulfill the same function?
- ➡ What are the costs of new alternatives ?

The training required for value engineering

Value analysis

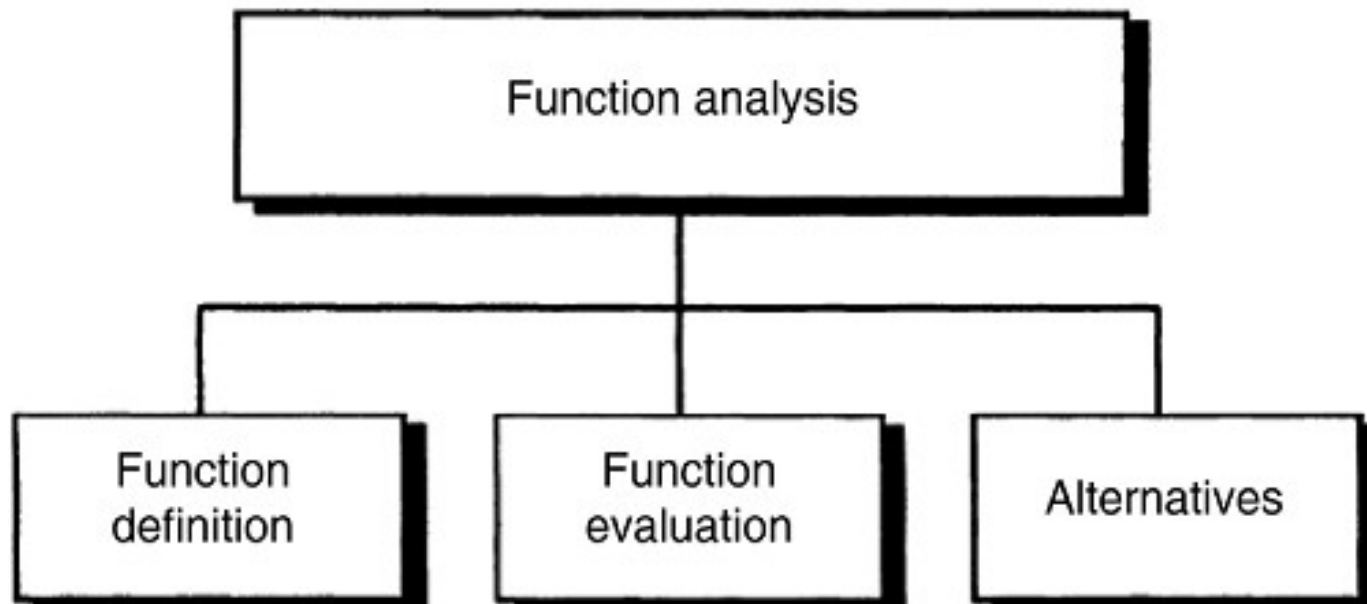
1. Priority matrix
2. Nominal group technique
3. Qualitative function matrix
4. Benefit curve
5. Expectations Matrix

The training required for value engineering

Function analysis

The failure to provide buildings or parts of buildings which properly perform their functions is a common problem in the construction industry and it is this that forms the basis of function analysis. In the context of function analysis, it is assumed there is a close relationship between the provision of function and the achievement of value.

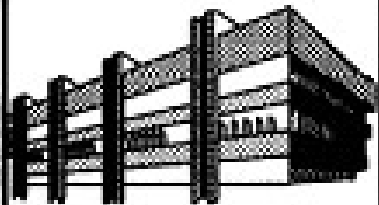
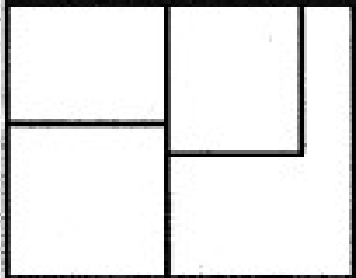
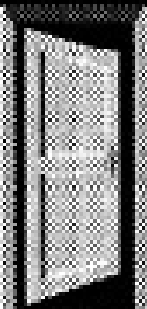
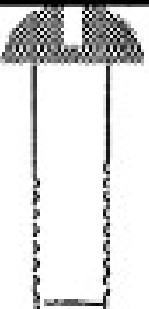
Function analysis



Function definition

- Defining the function of the project as a whole
- Defining the functions of spaces within the project
- Defining the function of the elements
- Defining the function of components

Function levels

			
Project functions (high level definition)	Space functions	Elemental functions	Components (low level definition)
Educate children	Seat children House staff Deliver meals	Admit access Deny access Maintain environment	Hold head
High potential for change High potential for improving value			Low potential for change Low potential for improving value

The training required for value engineering



Cost estimation

Cost estimation is the first step before designing production methods for a new product. At this stage, the processes are performed according to the clients, and they focus on design of production, and it performs throughout the life of the product.

The purpose of cost estimation in value engineering is developing the required production process in order to gain the desired profit.

The training required for value engineering

Cost estimation

In traditional perspective

$$\boxed{F = M + k} \quad (\text{F: Price, M: Cost, k: Profit})$$

In value engineering perspective

$$\boxed{M = F - k}$$

The training required for value engineering

Decision makers/ responsible parties in value engineering:



Value manager



Project management team



Project manager



Technical resource manager



Team leader in value engineering application