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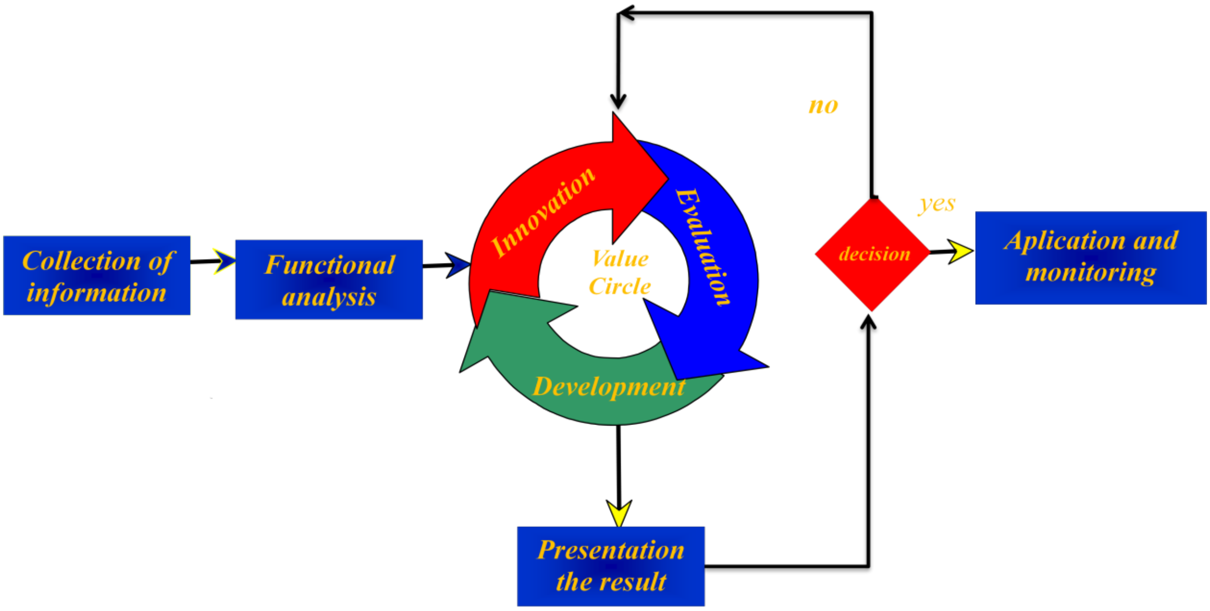
VALUE ENGINEERING IN CONSTRUCTION



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❖ Introduction

Value engineering, as a working method, it was appeared in the U.S.A during the Second World War. After the war, it was noted that in many cases a return to original projects (where the products were made from deficient materials) was not justified, because many of the new products worked so well - if not better, and besides, their production was less expensive.

Value Analysis techniques are recognized globally as a highly profitable which helps to achieve profits growth, customer satisfaction and better quality. Applying value analysis uses powerful, creative, value-based decision making processes that have been used and improved worldwide for over 60 years, with full success. Companies have used this method to save costs and / or increase profits. These results have been obtained many times simultaneously with increasing product quality, utility and customer satisfaction as well as other improvements related to meeting the essential requirement of the product. These benefits are provided through the use of "value engineering studies" by creative thinking of a working team which forms from different specialists.

The value analysis is based on the functional approach since the beginning of the projects. It originated during the Second World War at General Electric Company, USA, when innovation was needed to cope with material shortages. Some critical material was difficult to obtain and therefore a large number of substitutions was needed. Dr. Harry Erlicker, a vice president, noted that these changes often led to lower costs and better products. This work encouraged him to seek an approach to deliberately improve the value of the products. He attributed to Lawrence D. Miles, a hired engineer of the company in the 1940s, the task of finding a more effective way to improve the value of a product. In 1947, Mr. Miles and his team developed a step-by-step system called value analysis to analyze the cost and function of a product in order to identify and eliminate unnecessary costs. As a result of the substantial investments made, the new methodology "value analysis" has been developed, tested and proved to be extremely effective. (1)

1952, Great Britain introduces Valuation Analysis, the most consistent program being launched since 1961 at Dunlop.

1954, the US Army implements Value Analysis for its own industrial activities.

In 1956, Robert McNamara (the state secretary of defense from Ford) launched a defense cost reduction program based on the following principles:

- in order to ensure that tactical operations are prompted to buy only what is needed;
- buy at the lowest price and required quality;
- reduce operating costs by eliminating unnecessary operations, using standardization and modularization.

[(1)]. Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010.

The American Society of Value Engineering (SAVE International), a professional society, organized in 1959 to promove the knowledge and application of value analysis, defines value analysis as "the systematic application of recognized techniques to identify the functions of a product or service, to establish a monetary value for functions and to provide the necessary functions at the lowest possible global cost. "

Also in 1962 Value Engineering Ltd was born in England, and in 1978 "Societe Française de Valens (SFAV)" and Society of Japanese Value Engineers (SJVE) in Japan. The method then extended to Germany and Austria, and later to the Eastern European countries. In Romania, the method has been used since the 1980s, after the two standards for value analysis were developed.

1961, Lawrence D. Miles, publishes the paper "Technics of Value Analysis and Engineering".

1966, Yoji Akao, launches "Quality Function Deployment" (QFD) - an extension and development of the new method that aims to meet user requirements at all stages of product development.

1974, "Zentrum Wert Analyse" (ZWA) - the German Value Users Association.

1978, "L'Association Française pour l'Analyse de la Valeur" (AFAV) - the French Association of Value Analysis users.

1979, Romanian Standards are published: "STAS 112721 / 1-1979" - "Valuation analysis. General notions "and" STAS 112721 / 2-1979 "-" Value analysis. Applying the Method to Products ".

Over time, value analysis and engineering has gained prestige as a proven method and a useful tool for modern management. Nevertheless, the understanding of the method and the skills needed to exploit its potential are still under development. The following will address issues related to the definition and purpose of value engineering.

CHAPTER 1: Concepts and objective of value analysis

Studies can be made on existing projects, on projects under development or on projects under conception. The terms of value analysis, value engineering, value control and value management, although they have specific definitions and have some peculiarities, refer to the same basic methodology, so they have become the same. [2]

- **Value analysis**

Studies on existing projects are referred to as value analysis. In these studies can be known many things about the current situation, and the value analysis team is reviewing the project to improve the situation. Generally, some cost savings identified through value analysis studies are used to substantiate the cost of change. This term is sometimes used to describe the application of the methodology to a process or procedure.

- **Value engineering**

Studies on projects under development are called value engineering. In the field of value engineering studies, only critical project information is known, and the value analysis team makes project analysis before spending a significant cost on the project, thus significantly reducing the cost of change. Value engineering applies to developmental projects of various types, eg new product designs, manufacturing processes, procedures, organizational studies.

- **Value control**

Value control requires the application of the methodology at the beginning of project, for setting the quality and cost records, for the development of the project concept, to ensure the project's viability for the client. Valuation studies are often followed by value engineering studies, as the design progresses, to continue to optimize the design and manufacturing process. Business planning or operational planning studies, as well as business reengineering studies, which also use value methodology, are considered value control studies.

- **Value management**

At present, it is considered that value management has become the accepted term in a general way that includes all the previous ones. Regardless of the type of study, the approach and basic techniques of value analysis are the same. The major difference lies in how to prepare training and information for the efficient conduct of the study.

1.1. What is the value?

Value is a certain relationship between something (an object, an idea or a process) and a subject that evaluates. The value means some thing is good and to realize the scop. (3)

Value is a very subjective concept, it has different meanings for different people. A consumer will consider it "the best merchandise", a manufacturer will consider "the lowest cost" and a designer will see it as "the greatest functionality."

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[2]. Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010.

Value is not self-contained: "In other words, value is a concept of time, people, subject, and circumstances, not just the subject alone." (Snodgrass and Kasi 1986, 257).

"Customer Value = NOT MORE = (Needs + Objectives + Targets) / Maximum overall Resources Expended". Good value "is achieved when a balance is achieved between quality and resources.

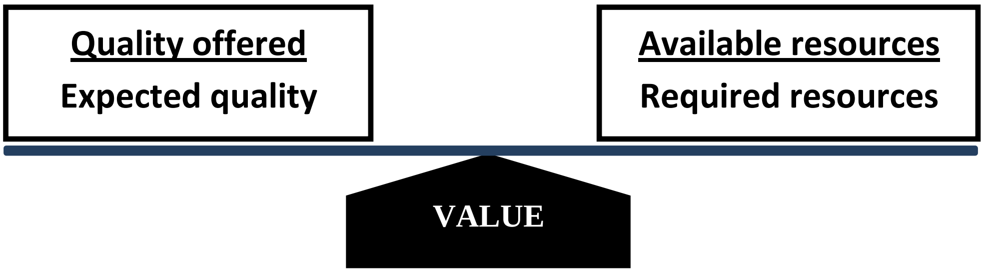

Figure 1.1. Value scale (Value management practice / Michel Thiry)

In the competitive world of today, a company can be profitable and the market leader in the market provides value to customers. To achieve this, it is necessary to understand the various aspects of value. This is imperative because such issues are those that meet the needs of the consumer and motivate him to pay for the product or service.

In dictionaries, the value is defined in several ways. From the point of view of philosophy, value is the appropriation of things, facts, or ideas to meet needs. Value represents merit, as utility or importance to the possessor. Other definitions have value as a reward for something. It mirrors how much it deserves, estimated or evaluated.

Since ancient times, philosophers have been concerned about this concept. In 350 BC, the Greek philosopher Aristotle identified seven types of value:

- Political value
- Social value
- The economic value
- Religious value
- Ethical value
- Value of perception
- Legal value

In trade, the phrase "makes money" is used in connection with a sales product. Both salespeople and advertising specialists highlight the virtues of the goods or services offered, encouraging customers to buy them. They emphasize the fact that the product offers quality, reliability and price that is able to satisfy the buyer.

1.2. What is value analysis?

Value analysis is a systemic, critical and creative method of research and planification, which anylizes the functions of the project to be designed and realized with minimal costs and quality conditions that satisfy the needs of the customers in accordance with the Romania norm - STAS R 112721 / 1-79.

(3) ANALIZA VALORII / Gheorghe Coman, Casa de Editură Venus, 2001.

Value engineering is a method for eliminating unjustified costs of the product or service from the conception and design phase. Value analysis is the only technique that reduces costs, while enhancing the functions in order to improve value. By using the technique of analyzing value, customer requests are established and maintained in the mainland. The functional approach to value analysis meets the expectations of customers at the lowest price.

Value analysis is a methodology based by function analytics and it is used to improve business by identifying opportunities to remove unnecessary costs in their services, while ensuring the quality, reliability, product performance, and other factors demanded by customers.

There are two key aspects that distinguish the value analysis from other management tools, and these are:

• The unique method which based by functional approach of the project;

• Operational plan for the implementation of projects.

The effectiveness of value analysis is to use creative techniques at the right time. Value analysis is not just a good practice methodology, it is not a suggestion program, and it is not a routine review, but an independent project approach. (4)

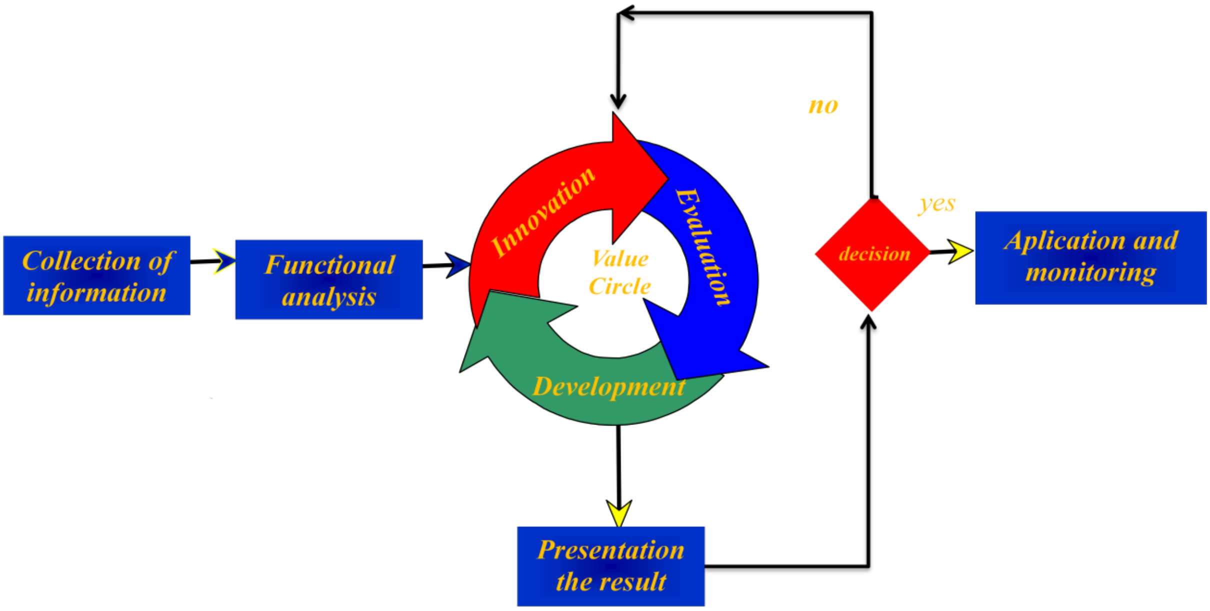

Figure 1.2. Phases of value engineering

Value analysis studies have a broad scope, the most common apply to:

- products (goods and services)
- manufacturing processes
- administrative procedures

(4). Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010

- organizational studies
- business planning
- reengineering
- construction projects

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1.3. Areas of implimntation

The areas of implimntation of this method are mainly the following:

- research and design of new products and modernization of the current production;
- research and design of new technologies and existing modernization;
- perfecting of the serving and auxiliary processes in the economic units;
- provision of services;
- design and realization of investment objectives and projects;
- improving work processes.

The value analysis method is applied in order to develop more or less complex products. There are two levels of applicability of the value analysis method.

- the first level refers to the modification of an existing product;
- the second concerns the design of a new product.

The application of the value management principles in the case of existing products presents the advantage of being able to compare production costs for the original and modified products. But value management is not only used in the field of product design, but also in the operation phase, the administration, as long as it applies the functional analysis of operation phase.

1.4. Benefits of value analysis

Unemployment and rising costs have prompted organizations to recognize the need to use scarce resources when offering products and services. Value analysis is a technique oriented to a function that has proven to be an effective management tool for achieving improved design and manufacturing, and cost-effectiveness in various programs. It is considered that the successful implementation of a value analysis program results in additional benefits beyond design and cost savings, eg constantly updating standards and policies, accelerating the incorporation of new materials and manufacturing techniques, enthusiasm for employees relative to participation in company decisions, improved skills gained through participation in teamwork.

Value analysis is one of the most effective techniques known to identify and eliminate unnecessary costs in product design, testing, production, operation, maintenance, procedures and practices. It simply does not reduce costs to make the product or service "cheaper", as is the case with the usual and traditional methods. Instead, the value analysis approach determines the value of the basic function without considering applications, establishes a cost objective and finds alternative design solutions that meet all needs at a lower total cost.(5)

Other MV objectives are:

- a reduction in production costs;
- satisfying the requirements of the user;
- testing new performance through limited cost increases;
- simplifying manufacturing processes;
- encouraging teamwork;
- a promotion of creative thinking.

Starting from the social needs and based on the application of the law of economy, as well as of the latest achievements in science and technique of value engineering, we aim to establish an optimal ratio between the value of function (F) and the direct and indirect production costs generates them (C). This is the fundamental objective of the method and can be expressed in a mathematical relationship, as follows:

$$\frac{\mathrm{F}}{\mathrm{C}} = \max \qquad (1)$$

The principle of the systemic approach promoted by value engineering, the objective expressed by the relation (1) is considered to be achieved only when the result optimizing all reports in relationship (2):

$$\frac{\sum_{i=1}^{n} F_i}{\sum_{i=1}^{n} C_i} = \max, \ (i = 1,2,\ldots,n) \qquad (2)$$

in which:

F - function of the product;

C - the cost corresponding to the function i;

i - the function number of the product.

Another scop of value engineering is the generalization of the technological, constructive, organizational solutions demonstrated as being economically optimal for all products, services, etc. Among the objectives pursued by value engineering is the increase in the value of function of the products, even if the costs are not reduced or even increased, but within a certain limit.

Apart from the direct economic effects corresponding to the objectives pursued, the value engineering study generates a series of indirect, derived economic effects. Thus, by applying value engineering to redesigning the products of the organization, some major deficiencies in the organizational system can be highlighted, generating losses in different phases of the manufacturing, supplying, selling processes. Also, through their results of value engineering studies create a state of employee emulation for creativity, a new attitude to the role of the economic factor in the conception and realization of material and products. [6]

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[5]. Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010.

[6]. VALUE ANALYSIS AND VALUE ENGINEERING for Architects, Engineers, and Builders/Muthiah Kasi/1994 by Board of Regents of the Univer

1.5. Function types

Functions are our needs, desires, or requirements, depending on the point of view or the derision of the analyst. Function is the property that makes something work or sell. Therefore, there are two types of functions: **usage functions and sales functions**.

The purpose for which the customer needs the product is the usage function. The usage function of a pencil is to "make a sign". If the pencil is not able to make signs, then it is useless for the client.

The function that fulfills a client's aesthetic desire is called a sales function. This is the result of those products that offer aesthetic attractiveness and help in selling. If a rebate pencil "improves the appearance", it will be much more desired by the client. There are two levels of functions within the project scope: **the basic function and the secondary function**.

The basic function, also called primary function, is the specific work that the product, process or procedure is designed to perform. If the product function is removed but the product still exists, then it is clear that the selected function is not its basic function. For example, if the basic function "make a sign" of a pencil is removed, there is no necessary any reason for the pencil to exist. The basic function is also that function or functions that depend on all other functions. If the basic function is not necessary then none of the secondary functions will be needed.

Secondary functions are the other functions that perform the product, and they are subordinate to basic functions. These functions are generated by the specific project or the process that is adopted to perform the basic function. They support basic functions and allow the product or service to function and sell. Secondary functions can be classified into three classes: **necessary, aesthetic and unwanted (or unnecessary) functions**.

The secondary functions are required to allow the base function to take place or to perform better. Secondary aesthetic functions improve the appearance of the product and make it more desirable by the client. Unwanted side effects are generally secondary results of either the basic function or other secondary functions and often require additional costs to minimize their impact. To identify a secondary function, this feature is removed from the product or service. For example, the function "improves the appearance" of a pencil is a secondary aesthetic function, and the removal from the product will not prevent the pencil from being functional. An incandescent lamp also has the " produce a heat " function, which is an unwanted side function, generated by the design solution chosen. [7]

There are many ways to classify functions as shown in figure 1.3:

- according to Romanian standards;
- according to foreign standards (AFNOR, etc.);
- according to prestigious professional organizations (SAVE).

[7]. Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010.

Normally we should use the classifications and definitions related to the Romanian standards. If the different definitions of functions are convergent, the difficulty is not to classify the functions.

- **According to STAS R112721 / 1-79, as shown in figure 1.4, the functions can be classified into:**
  - By their importance:
    - Basic function - the function corresponding to the main purpose of the vehicle is intended for the studied product and which directly contributes to the achievement of its intended use.
      E.g:
      - an electric radiator emits caloric energy;
      - a cooker too;
      - an armchair bears a certain weight;
      - a musical instrument emits sounds;
      - one shaft transmits a torque,
    - Secondary (or auxiliary) function - the function that serves to fill or complete the basic function and indirectly contributes to the realization of the value of the object. It is often conditioned by the technical solution adopted.
      E.g:
      - a product name label provides information to the consumer;
      - the flickering effect of "coals" on some electrical dildos increases the attraction by simulation;
      - the wheels of an armchair offer the advantage of reducing friction when the wheel is moved;
      - a box in which a musical instrument is kept offers its protection, etc.
  - After the measurement possibilities:
    - Objective function - the function that can be characterized by measurable and quantifiable objective dimensions by means of several measuring units. For example, the function of an electric motor to deliver the torque (torque and speed) always has a watt dimension (wattage) can be precisely measured by those to whom the product is intended.
    - Subjective function - the function that can be characterized by psychosensory and social, organoleptic, aesthetic, demode, prestigious, etc. The dimensions of the subjective functions are estimated through the intermedia of the survey or statistical survey. For example, the aesthetic qualities of a car determines the resistance (sometimes from sins, most of it) of its value.
  - After their contribution to the value of the object:
    - Necessary Function - the function that contributes to the realization of the value of the object.
    - Unnecessary function - a function that does not contribute to the value of the object.
    - Harmful function - which diminishes the usefulness of the product.

- According to the time of the analysis:
  - Existing function - the necessary or unnecessary function that the subject studied when performing the analysis.
  - New function - the required function, derived from user requirements, attributed to the object studied after the analysis.
- After the importance of the function for the product:
  - primary function - without it the product does not exist;
  - complementary function - the function that enhances the usefulness of the product;
  - Restriction function which exist due to restrictions imposed on the product;

♣ **According to the French NF X50-150, the functions are classified into:**
  - service functions (external);
  - technical functions (internal).
  - Service functions are the expected action of a product that responds to a user's need. Sometimes more service functions answer a need.

Service functions include usage functions and appreciation functions. Usage functions; express the rational, objective part of the necessity. Appreciation functions; correspond to the subjective functions resulting from psychological, affective motives. They are related to the aesthetic aspect (fashion, taste, snobbery, infatuation, etc.) or to the presence of an element of value. The functions of appreciation mainly influence the commercial side of the product, making it easier to sell.

Examples of appraisal functions:

- on a pen: "to have the golden pen";
- on a machine: "have a modern design";
- on a coat: "to be firm";
- on a mobile phone: "be the last model".

Technical functions represent the internal action on the product (between its components) chosen by the designer to ensure deservice functions. A technical function responds to a technical need of the designer and is ignored by the user. Technical functions do not directly give the product value. The technical functions are the support of the service personnel, without them the following could not be satisfied. For example, the cooling of the internal combustion engine is not a function of the product but a technical one, but without this engine service function it develops a motor moment can not be satisfied. The technical functions of a product define subassemblies and the user is interested in them. A technical function must always be the consequence of a deserving function (utility or appreciation)

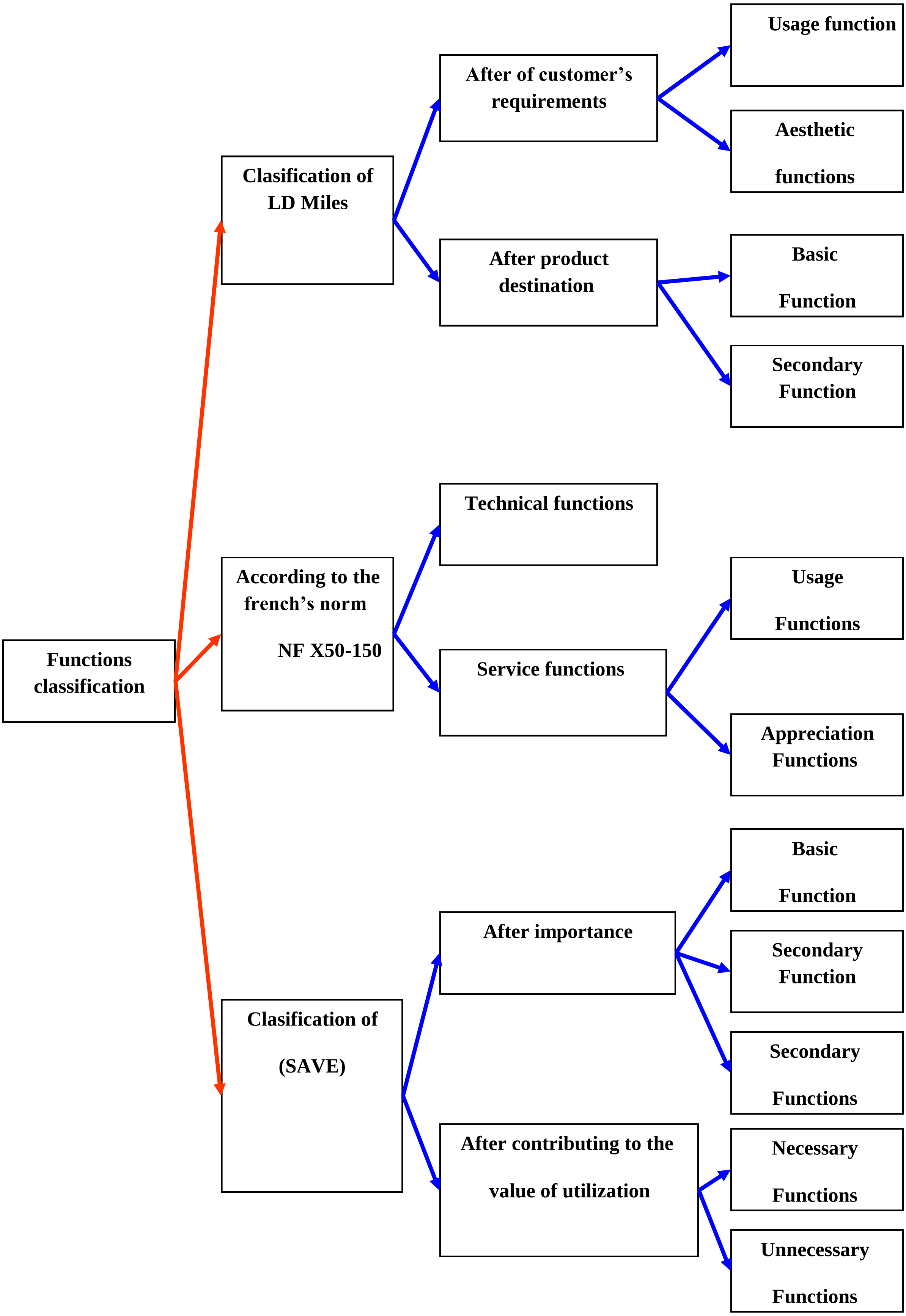

Figure 1.3. Functions classification of product

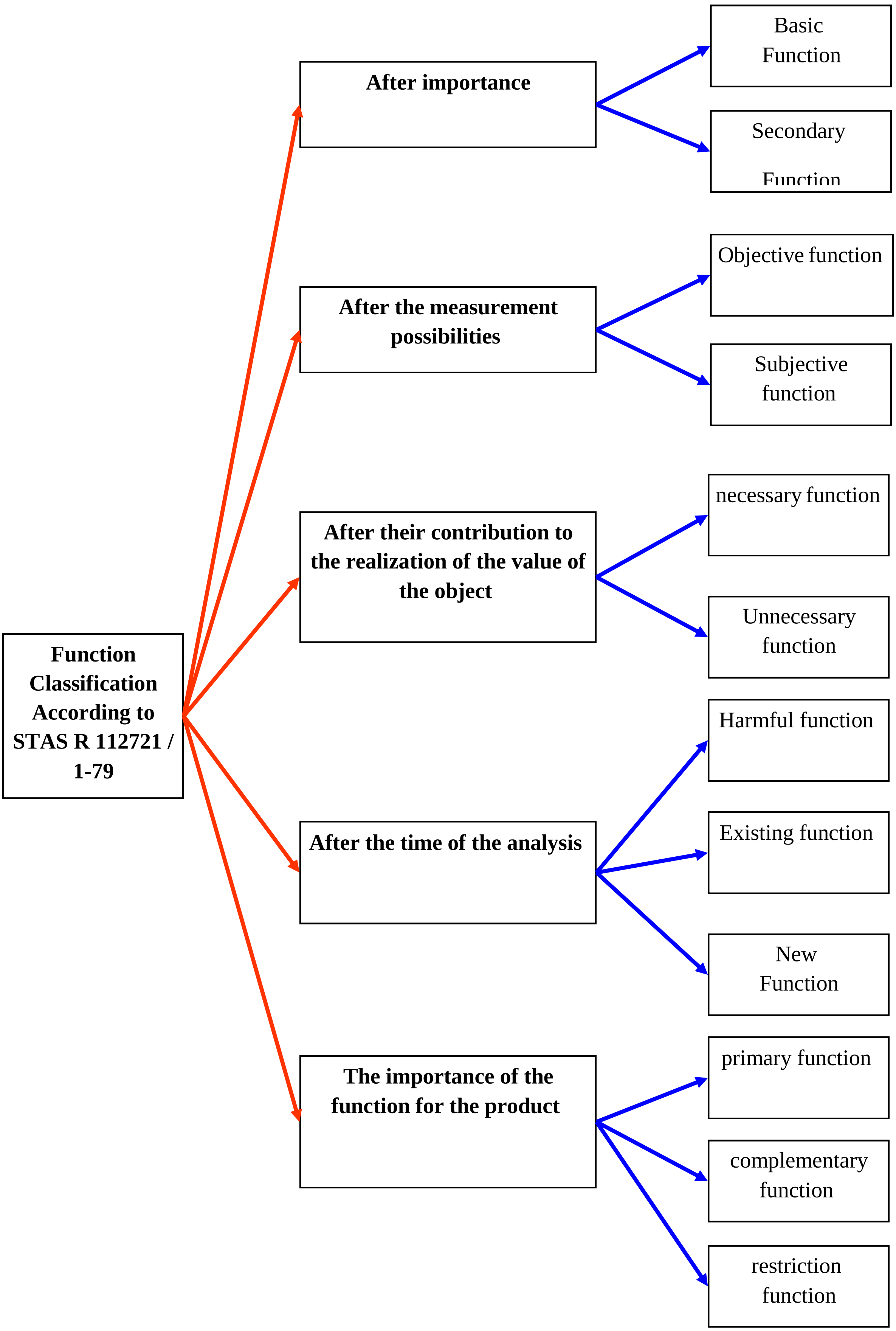

Figure 1.4. Functions classification of product according to STAS R 112721 / 1-79

CHAPTER 2: Phases of the Operations Plan of Value Engineering

The value analysis follows the general model of scientific methods, namely the formulation of the problem, its solution and the application of innovations in a collective group characteristic of group dynamics.

In the following we will go through the steps and phases recommended for the application of the value analysis method to the research and design of new projects and the modernization of the current production.

The techniques and procedures of work, as well as the degree of deepening of the phases of application of the value analysis, are determined by the working team which takes in its view the complexity of the studied project, the size of the production series, the technical, economic and organizational possibilities for solving the problem addressed.

Figure 2.1. Phases of plan of value engineering

2.1. Phase 1: Gathering Information

This first phase is intended to provide the members of the value analysis team with a basic understanding of the project by collecting and reviewing the appropriate information before starting the study itself. Required information is slightly different depending on the type of study. Besides the background information related to the project in the study, the team needs to know well what the needs and requirements of the client are. The objectives of the project will be defined and analyzed. The purpose of the project will be determined clearly, determining the quantities and life (reliability) of the product; marketing conditions; reviewing cost data; looking for additional information needed, highlighting important items so that team members can focus their attention and efforts. The current costs of the project will be highlighted and organized. The key tools used in this phase are numerous, among them cost modeling, graphs of the process (eg general graphs, flow charts), Pareto analysis, etc. (8)

2.2.phase 2: Functions Analysis

The functional approach of the projects represents a major advantage of the value analysis methodology, as compared to other cost management methods. Therefore, special importance is given to the functional analysis phase. The objective of the function analysis phase is to identify functions that do not provide good value and therefore require improvement.

There are three stages of the function analysis phase. The first step is to define the functions developed by the design and to establish the category of each function. The second step organizes the functions previously identified by the function analysis system technique in a FAST chart(function analysis system technique), to graphically illustrate the reciprocal relationships between functions. The third step of the function analysis should identify which of the project functions requires improvement. This is done by dimensioning the FAST diagram. First, the cost of the functions is determined, this process involving the allocation of the cost of the product / service to the functions it performs. Another important part of the step is to determine the value of the functions. During this process, the team will find out what functions are costly and do not provide good value to the customer. Usually, a project identifies about three or four functions that require improvements, chosen on the basis of cost-function relationships or based on identifying them as the origin of problems of quality, reliability, efficiency, etc.

2.2.1. Technical dimensioning of functions.

The level of achievement of a function is expressed by its technical dimension, and the determination of this level by means of one or more specific measure units is called the technical sizing dimension.

- ♣ For an existing product, the technical dimensions of the functions are expressed by the technical parameters of the product, provided in the technical documentation or directly measured.

In the case of a new product, the technical dimensions of the functions are determined on the basis of the confrontation of the data resulting from the investigations of the user's actions with the technical parameters of the existing similar products as well as the technical literature.

(8). Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010.

Each technical dimension is expressed by the name of the respective characteristic, value, unit and the results obtained at this stage are synthesized by each function in the nomenclature.

- ♣ The technical dimensioning of the subjective functions can be done by estimating and quantifying.

2.2.2. Economic dimensioning of functions

The economic dimension of functions is represented by their output, and the action that determines the production costs of functions is called the economic dimension of functions.

The economic dimension of each function results from the summation of the costs of the component elements that materialize the respective function, namely the costs of material, labor, energy and directing of the structures performing the functions of the product.

- ♣ It can be noticed that the economic dimensioning of jobs requires a lot of work, being the most laborious of all the phases of value engineering research, but the richest information resource.

2.2.3. Systemic analysis of function

- ♣ The systemic analysis of function aims at identifying fictitious functions, which by way of realization (constructively, technologically and economically) exert a negative influence on the ratio: use value / production cost.
- ♣ This analysis involves a critical assessment of functions based on specific criteria.
- ♣ Critical evaluation of the functions of a product is performed using three main critical of analysis,it;s called:
  - a criterion of utility of functions;
  - a criterion of the technical dimension of the functions;
  - a criterion of the economic dimension of the functions.

2.3.Phas 3: Investigation

During this phase, each of the functions identified in the previous stage is investigated as requiring improvements in its own creative session. Functions that cost a lot and do not represent an attractive value for the client need to be redesigned, so efforts are being made to discover any idea that can be associated with modifying the function. Typically, these activities are carried out using the Brainstorming technique, focusing on the amount of new ideas to perform the function investigated. To be successful, all the ideas found during the Brainstorming session are recorded in order of appearance, and judging the quality of ideas is forbidden, not to inhibit creativity.

There are several factors that stimulate the need for creative processes. Any project is a compromise that gets the best solution at that time. Creative opportunities are always present in industrial activity through the exploration and development of new technologies, materials, manufacturing processes. Customers' wishes and needs are constantly changing and require creativity to be met. The functional analysis phase has indicated to the team what direction it is necessary to develop new ideas for product or process improvement. Now is the time for the value analysis team to capitalize on their creativity. In most industrial organizations it is difficult to be truly creative because the work environment generally requires solutions, not just ideas. People do not want to look stupid by exposing an idea that might not be a viable solution or would be completely new to traditional thinking. However, without a serious search for new ideas, the best solution may never be discovered.

During a creative session, an open and positive atmosphere is maintained, encouraging the generation of ideas. Every idea must be expressed and recorded. Explained ideas can become inspirational for other team members. In order to guarantee the free generation and the expression of ideas, the members of the team abstain from commenting on the ideas of others but refrain from judging their own ideas. The goal is to get a long list of ideas, not answers. By developing a large number of ideas, the probability of selecting the ideas best suited to the project criteria increases.(9)

Creative thinking is a product of imagination when a new combination of thoughts and things are put together. "Lawrence D. Miles".(10)

❖ **Some basic rules apply to creative thinking:**

1. Write all ideas and comments.
2. Target quantity rather than quality.
3. Exclude criticism; assume that each idea will work.
4. Hold judgment until the evaluation phase.
5. Eliminate "impossible " from your vocabulary.
6. Let your imagination roam free (the craziest ideas are often the most important).
7. Use piggybacking (build on other ideas and comments).
8. Cross -fertilize ideas (associate or modify ideas and comments).
9. Let everybody talk; do not interrupt!
10. Build a friendly competitive atmosphere.

❖ **Creativity groups provide:**

1. Good mix of people with no major power relationships.
2. Positive attitude; belief that the project can be improved.
3. Good communication; remove mental blocks.
4. Free -flowing ideas; no logical sequence.
5. And remember that all great ideas seem absurd when first proposed.

❖ **Increase creative thinking.**

The most important factor in the development of a productive creative effort is undoubtedly a good atmosphere. Each level of management must establish a creative environment in its area of responsibility. Subordinates must be encouraged to engage in creativity. Some positive action guidelines are:

(9). Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010.

(10). Value management practice / Michel Thiry/Library of Congress Cataloging-in-Publication Data/ USA,1997.

1. Establish and initiate a policy that encourages creative ideas.
2. Initiate a training program that explores creative techniques.
3. Establish an incentive policy to identify areas that can be improved.
4. Provide an open and objective assessment of all recommendations.
5. Encourage employees to discuss decisions that involve their tasks.
6. Identify people who have constructive, creative ideas and be allowed the freedom to perform their tasks at their own professional standards, even if their ideas may be opposed to the current policy.
7. Establishment of brainstorming teams for free and constructive thinking without organizational restrictions.
8. Establish an incentive recognition and awarding program to identify all individuals or groups that contribute to creativity and productivity.
9. Encourage the flow of information both up and down within the organization and develop loyalty and mutual trust within the group. (11)

2.4.Phase 4: Evaluation

At the beginning of the evaluation phase, the criteria to be considered when judging the ideas to be assessed are identified. Then the ideas are discussed and evaluated from the point of view of evaluation criteria, they are also highlighted and additional advantages and disadvantages are noted. Based on this analysis, ideas are hierarchized according to priorities for further developments. If there are many alternatives for a specific area, then use the techniques of comparative analysis to decide which of these mutually exclusive solutions are closest to the project's objectives.(12)

Separating ideas involves sharing them into different categories. In general, four groups of ideas are identified:

- ♣ ideas that reduce resource spending,
- ♣ ideas that avoid resource costs;
- ♣ ideas that improve the performance of the project;
- ♣ ideas that increase resource costs but lead to better value.

The purpose of this phase is to systematically reduce the large number of ideas generated in the previous phase, in the phase of investigating a number of concepts that seem to promise to achieve project goals.

The stages of the evaluation phase of the ideas are as follows:

A. Determination of evaluation criteria;
B. Evaluation of Ideas;
   - Testing in terms of criteria
   - Identification of the advantages and disadvantages
   - Total appreciation of ideas

(11). Value engineering program management guide/u.s. army materiel command pamphlet 11-3/ MARCH 1997.
(12). Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010.

C. Comparative Analysis; comparing value analysis options. Who benefits ?. The upper and lower limit for the value of the opportunity and the opportunity's benefit; Comparison of value analysis techniques; Utility adjustments (main function and secondary functions) and effectiveness (cost or price); Using the table with the mention of the advantages and disadvantages;
D. Appreciation of alternatives;
E. Calculating the total score for each alternative;
F. Estimating the cost of each alternative;
G. Calculating the fraction of the value;
H. Selecting another ration that offers the best total value.

2.5.Phase 5: Dezvoltation

The product can be improved by creating an atmosphere conducive to new ideas; Encourage inventive personalities; Creating conditions for discoveries; Encouraging inventive actions; The process of invention and discovery.

Innovation means setting up barriers to innovation; Defeat these obstacles; Discussing the innovation mechanism; Adapting to change; Creating change; Maintaining an objective attitude towards the product; Identification with the product; Search for analogies; Searching for "exit solutions"; Sorting solutions found. (13)

Good results are obtained by combining the strengths of different ideas. Development should include the following steps: (14)

1. Researching and adding information to support the approach.
   a. Separating ideas that are industry standards.
   b. Recognizing ideas that are not tested.
   c. Awareness of ideas that are controversial.
2. Recognize ideas that can be unique through optimization and simplification.
3. Involving specialists to support and perfect ideas.
4. Prepare cost estimates.
   a. The impact on the customer (s) is considered.
   b. Use the cost to perform the profitability analysis rate.

c. Taking into account the cost of the life cycle.

5. Analyze risks and support ideas accordingly.

2.6.Phase 6: Prezentation

Written reports are the evidence that remains after the flare is gone. They should be well organized and cover the value study process in de-tail. There are basically two types of reports: management report and de - tailed report. A typical table of contents is presented here for both types of reports.

(13). ANALIZA VALORII / Gheorghe Coman, Casa de Editură Venus, 2001.

(14). Analiza valorii, by Ion IONITA, ASE Printing House, Bucharest, 2008.

- ♣ Management Report
  - a. Executive summary
  - b. Backgroand of Project (goals, expectations, parameters, constraints, and so on)
  - c. The objectives of the value study
  - Reesablish goals
  - Restate the problem
  - d. Summary of the proposals
  - e. Benefits
  - f. Recommendations
  - g. Implementation of the plan. (including implementation conditions)
  - h. Conclusions.
- ♣ Detailed report
  - a. Introduction
  - List of participants
  - Agenda
  - job plan
  - Outline of the value study process
  - b. Classification of value management proposals (VPCs)
  - c. Summary of value management proposals
  - d. Detailed value management proposals grouped by function/element/ component
  - e. List of proposals
  - Detailed proposals
  - Annexes;
  - f. Complete list of ideas from the creativity phase,
  - Backup for estimates, life -cycle costs, quality, risk assessment,
  - and other supporting evidence
  - Support materials (plans, technical specs, standards, regulations, etc.

The work of the value analysis team is coming to an end. As the study is already completed, the team must report a summary of the value engineering. This phase consists of presenting the team's recommendations to decision-makers for approval and requires the following actions:

- Writing the written report
- Prepare the oral presentation
- Presentation powerpoint

The recommendations of value engineering have to contain proposals, the team must understand the procedure by which the proposals are examined, approved and implemented, they must know the official persons in the firm to whom these responsibilities are delegated and must establish the information to be submitted. This is done by using control lists, it's called:

- Checklist for current product / service
- Checklist for the proposed product / service
- Checklist for implementation
- ♣ The checklist for the current product may include the following (general example):
    - Description of the current product
    - Real product, if possible
    - Current cost, cost-function matrix
    - Current performance
    - Current profit
- ♣ The checklist for the proposed product may include the following (general example):
    - Description of the proposal
    - Model made, if possible
    - Test data
    - Current cost, cost-function matrix
    - Advantages / disadvantages provided:
    - Every cost and total program
    - In the management's cost objectives
    - In profit
    - In performance
    - Function Cost Matrix and Improving Cost of Functions
- ♣ The checklist for implementation must highlight:
    - Costs of implementation (change action)
    - Proposed Action Plan for Implementation [(15)]
- ♣ **Here are some useful suggestions for an oral presentation:**
    - Relax and talk informal (Conservation mode)
    - Speak rapidly ….but not quickly
    - Face the audience, look in the eye (3-5 seconds)
    - Learn your presentation point by point
    - Be excited and enthusiastic
    - Use clear good AV
    - You do not have to answer all the questions.
    - Face the people concerned (Decision maker)
    - Practice, Practice, Practice …see your self.
- ♣ **Presentation Format**
    - Introduction
        - Introduction of the VE Team Members
        - Define Scope
        - Main topic discussed
        - Function Analysis & FAST Diagram

[(15)]. Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010.

- Body
    - List of Ideas & Recommendations (20-30 ideas)
    - Total Saving (Addition)
    - Talk about 10 VEP
    - Present at least one WEM and one LCC
- Conclusion

2.7.Phase 7: Implementation

Putting it into practice by:

A. Factors that determine acceptance; what occasion should be used? Unexpected effort; Unexpected costs.
B. Acceptance conditions; Well-founded information (earnings, costs, risk); An honest provision (the effect on general objectives, the effect on departmental plans).
C. Mechanism of implementation; Determination of tasks; Who checks the task? Who does the work? Who will direct the progress of the works? Who provides the funds? Who controls the costs? Who reports the progress of the works? Who sets priorities and interference points? Determination of terms and sequence; Date when the action begins; How long will it take? How will the general outline fit? How long will the depreciation of costs need to be put into practice? How many units until balancing? Setting up tracking procedures: benchmarks, action plan reports, contingency plans to re-establish the action plan; Measuring results Scriptual calculation of all earnings in cash and time; Calculate all costs in cash and time; Comparison of net earnings with total cost of effort.

Examining these claims highlights the complexity of content issues in analyzing the value of products, processes and services. Of course, their general character must be taken into account, in that a space shuttle, rocket, airplane, radio or manual scissor (for example, a fixed or adjustable wrench, a screwdriver etc.). Depending on the complexity of the product, other claims may be added, but many of the above-mentioned ones may also be removed. [16]

If the conclusions of presentation phase conducted by the value analysis team have to finish successfully and the team's proposals have to apply these proposals into beneficial realities for the organization.

Implementation is not the responsibility of the Value Analysis team, however, the Value Analysis team will be interested in implementation phase. The formal process of tracking the status of project implementation and auditing results is useful for:

- Identification of problems and delays in implementation;
- End implementation on time;
- Verifying the final benefits.

[16]. ANALIZA VALORII / Gheorghe Coman, Casa de Editură Venus, 2001.

CHAPTER 3: Implementation of value engineering in construction

Through systemic and functional analysis, the value management defines practically the research directions for the improvement of the studied project, when the creative act begins. To do this, we need to use established methods of creativity.

The process of designing or redesigning a project is a process of technical creation. During this phase, the answer to Larry Miles's question is, "What else will the product do?" This phase is also known to be a phase of speculation. The information phase finishes with the development of the FAST diagram and the systematic analysis of the functions. Through the creativity phase we are looking for the best solutions for materials. There are many ways to generate ideas. Each of these can be successfully used. Value management does not impose a certain method of creativity. However, the most commonly used method is: (17)

3.1.FAST diagram

At the beginning of the sixties Charles W Bytheway, an engineer with Sperry Rand Univac Division, developed the Functional Analysis Systems technique (FAST) diagram (1985). FAST is a structure that targets organization functions in a logical and orderly manner, and may have been inspired the concepts of broken-down work structure (WBS) and the critical path method (CPMs) that were introduced and were very popular in project management at that moment.

Many engineers, who were targeting value, developed some individual versions of the functional analysis system chart, two of which were notable. Wayne Ruggles, then executive vice president of Value Analysis Inc., developed with J.K. Foulkes and John Groothuis, what is now known as the "FAST in technically oriented" Thomas J. Snodgrass, Chairman Value Standards Inc. and professor at the University of Wisconsin, has developed a technique based market research to compares a "value for customer" function together with Theodore C. Fowler, has developed "customer-oriented FAST" (Snodgrass and Kasi 1986. Snodgrass and Fowler 1972, sec 9.0). (18)

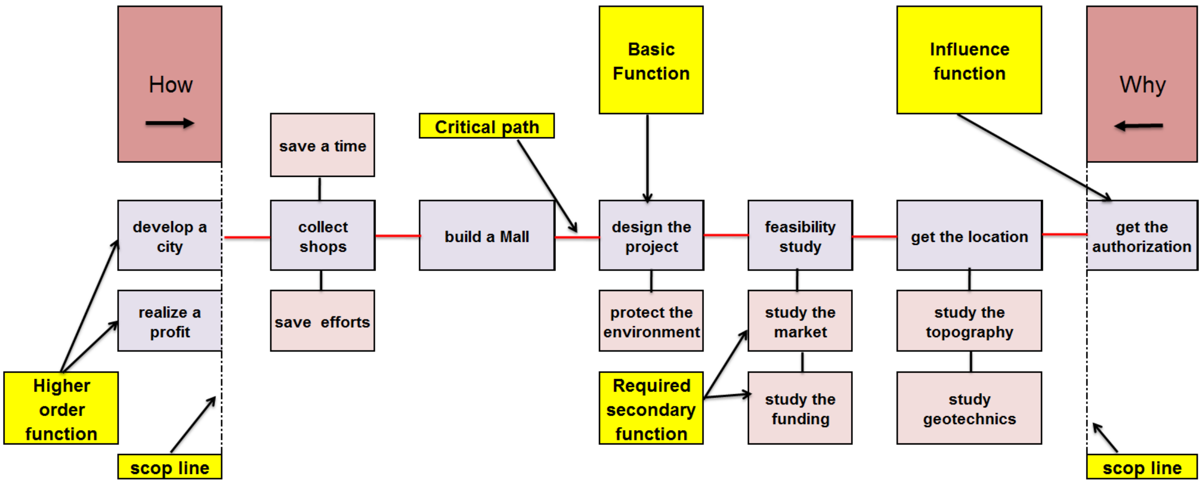

Figure 3.1. FAST Diagram of Mall

(17). Managementul si Ingineria valorii, CHIRCOR Mihael, Editura Universitatea "Ovidius" Constanta,2002.

(18). Value management practice / Michel Thiry/Library of Congress Cataloging-in-Publication Data/ USA,1997.

The Functional Analysis System Technique Diagram, shortly called the FAST Diagram, is a Powerful Technique of Value Analysis that:

1. Shows the specific relationships between all the functions of the project;
2. Test the validity of the functions to be studied;
3. Helps to identify the mission of functions;
4. Expand knowledge of the project of all members of the value analysis team;
5. Improves communication significantly, as it represents the team's consensus on the purpose of the project.

The FAST diagram appears to be similar to a flow chart. However, they are totally different because a FAST chart is function-oriented, while a flow chart is oriented by the time. Below are the components of a FAST chart.

- ♣ Scop line

The scop line is drawn as a broken line. Each study has two scop lines in a FAST chart because they represent the limit of the project being studied, and helps the team to focus on the stated purpose of the project. The scop line on the left is meant to separate the purpose from the upper order function, and the right side represents the purpose of the causal function.

- ♣ Logic HOW - WHY - WHY

There are a few lines in the chart, each containing a single function. Each function is bound to decelerate other functions using the deterministic logic HOW - WHY - WHEN. Logic HOW applies when looking for solutions to problems, ie from left to right. Reverse Logic WHY is being pursued to get solutions to problems and is made from right to left. The HOW and WHY logic apply only to the higher order function, the main (or basic) function, the required secondary functions, and the lower (causal) function. The WHEN logic determines the timing of occurrence or manifestation of functions. Functions are stacked and ranked "at the same time" and / or "caused by" another function. Logic WHEN also identifies functions that are "all time" and "one time".

- ♣ Higher order function

The higher order function is the need of user. So the higher order function is the function for which the project is designed. This function is placed to the right of the left-hand line because it is not a function of the project under study. However, it is the superior order function that generates the need to conceive the project. Is the answer to the question WHY applied to the "main function"? WHY DO WE DO THE MAIN PLACE? Answer: To get the higher order function.

- ♣ Main (or basic) function

This is the function for which the project is designed in response to the customer's requirements. It is placed on the right-hand side of the left-hand line. The main function is the answer to the question APPLIED to the higher order function. How to get the higher order function? The answer is "getting the main function".

♣ Required secondary function

There are some functions that are required to be present in the project, being necessary for the main function. These functions are called required secondary functions. In a project should not be more than five or six required secondary functions. These functions are related to the how and why logic line. The first required secondary function is the answer to the question HOW applied to the main function. How to get the main function? What work should be done to achieve the main function? The answer is "the required secondary function X". The other required secondary functions are the answers to the HOW questions applied sequentially on each required secondary function determined in the previous step. The logic relevance of HOW is checked with the WHY logic line. For example, the question is, "Why should I perform the first required secondary function?" The answer to this question is: "In order for the main function to take place." When both logic are satisfied, then it is confirmed that the functions chosen are indeed the required secondary functions in their logical chaining.

♣ Functions "at the same time" and / or "caused by" other functions

We have seen so far that, after the project functions have been identified, the team establishes the relationships between functions by using the HOW - WHEN - WHY logic. The how logic and why logic is useful for identifying the primary function and the required secondary functions in their logical order of dependence. Functions "at the same time" and / or "caused by" other functions are identified with the logic WHEN. These functions are placed under the function they are bounded by the WHEN logic and bind to a vertical line. If there are many such functions, they are placed vertically downwards in descending order of importance.

♣ Functions "all the time"

At the moment of the development of relations between functions, the value analysis team can find functions that respond to the amount of time, that is to the WHEN logic, but without having any relationship with other functions. These functions take place all the time, for example "prevents corrosion," "identifies manufacturer" or "improves appearance". These continuous-functions must be located at the top, right, next to the right-hand line.

♣ The "one time"

This feature only occurs once in the product, service, or system life cycle. For example, the "authenticate quality" function of a crimped portion of a glass cover is a "one time" function.

♣ Lower function

This function is also known as the "cause function" or "assumed function". It is placed to the right of the right-hand line. The lower order function is not part of the project, but it is the initiator of the project, the function that triggers the deployment of the other functions. It is on the same line as the required secondary functions, with the main function and the higher order function, so it responds to both logic HOW AND WHY. In other words, the logic WHY this function highlights the functions of the studied project.

- The objectives of design

The project in value analysis has some "design goals". They are placed on the main function. The outline of the scop frame can be done with a dotted line to distinguish project objectives from project functions.

- Critical path

The most important aspect of the FAST diagram is to build the critical path by identifying the functions that make up it and the specific location of each function in relation to the other. Critical path is the horizontal line joining the following functions:

1. Higher order function
2. the main function
3. required secondary functions
4. lower order function

Functions of the critical path follow only the HOW and WHY logic. So the functions on the critical path between the goal lines are the functions for which there is the project studied.

3.2.Value engineering team

Selected materials must be in accordance with the owner's design criteria. The architect-engineer is responsible for determining which materials are best suited to the economy, functions, and maintenance. In general, choosing most of the material is done by the architect or engineer working on a particular aspect of a design. For example, an electrical engineer selects items such as conductors, pipes, and panel boxes. The architect selects material for such items as windows, doors, and exterior finishes. In some important areas, economic studies are conducted, for example, in fuel selection and the structural system. However, in most cases, any selection of materials or any study is done by an individual or a group within the same discipline. Normally, no formal global plan is followed, nor are interdisciplinary benefits being developed, and no full-time employee is available to coordinate activities or follow through the development of new ideas .[19]

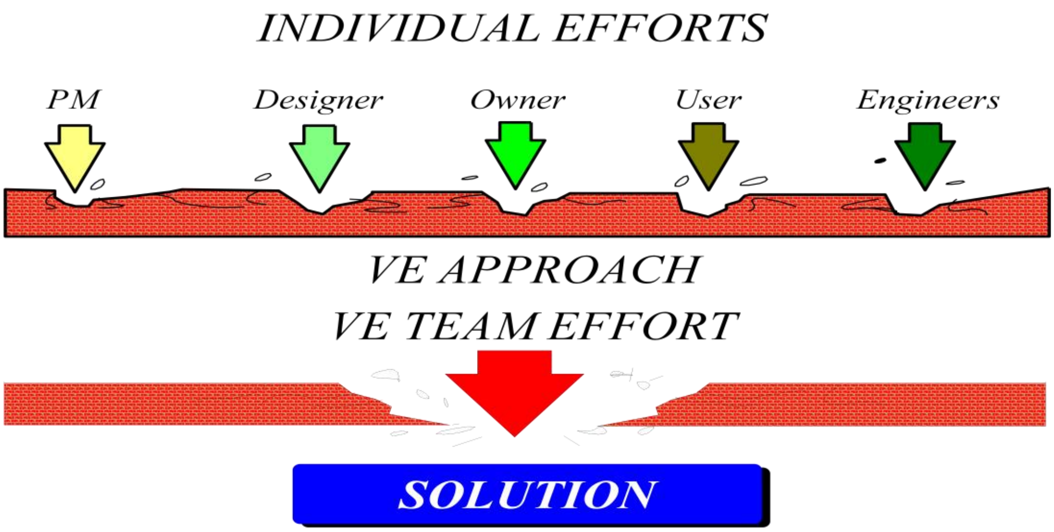

Figure 3.2. the power of the VE team

[19]. Miles D.L. Tehniques of Value Analysis and Engineering, Mc Graw-Hill Book Company, New York, 1989.

3.2.1. Roles and responsibilities

The purpose of a value methodology is to increase organizational value through a strategy, tactics, and operations with a focus on "customer need," cost effectiveness, and / or profitability. The link between value engineering and the organization is the role of management in improving value. There are two key management roles: Higher Management and Value Manager.

- **Responsibilities of senior management**

They are to ensure good leadership and make explicit strategic expectations in a conscious and priority way. Higher management should understand the potential benefit of a value study, endorse the cost of resources needed to support the study, guide the implementation and approval of the funds needed to deliver the recommendations.

- **Value manager responsibilities**

They vary over the life cycle of the project. At any time, the value manager must confirm that the methodological activities of value are coordinated and effectively carried out to meet the goals and objectives of the organization. A methodology of value can be used throughout the development project, with a different focus on each stage. At the conceptual stage, a value methodology can be used to determine the cost compared to the value of the core project functions. At this early stage, it is the responsibility of the value manager to ensure that all parties with a legitimate interest in the project participate in the value study, including suppliers, customers, end-users, users, and potentially interested outsiders, real needs "against" requirements "so as to provide maximum value for the studied project. Because the project is approaching the design phase, the value methodology focuses more on the functions of each element or component in the detailed design, the results of the function analysis, and the creativity being more limited because the resources have been allocated and the money spent.

At this stage of the project, during a value study, it is the senior manager's responsibility to assess which value alternatives are economically feasible on the basis of customer requirements.

While the project is moving towards the implementation phase (construction or production), the value methodology works to ensure that changes are made. Although many projects can still benefit from a value study at this stage of the project, it is the responsibility of the value manager to encourage early involvement of organizations affected by changes to ensure maximum benefit for any value study. For any given project, it is important for the management team to be aware that a value study carried out as early as possible brings a greater potential benefit to the client. Another role of the value manager is to ensure that activities take place before the meeting of the team responsible for value. These activities may not need the attention of the whole team. However, a successful value study is unlikely to exist without adequate planning and exchange of information so that all stakeholders clearly understand the purpose and details of the project. This, again, is the responsibility of the project manager. If these details are adequately communicated with the clients involved, the potential for a value study is greatly increased.

3.2.2. Revision of the Executive Committee

The leadership team sets the initial strategic goals for the value study and later it decides which results will be invested so that they can be implemented. These managers do not always participate in the day-to-day value of work but are part of the general value program. Sometimes managers are appointed as sponsors to support the value study and value program within an organization.

- **Technical team:**

  Those members of the value engineering team are elected on the basis of their technical expertise.

- Team members: It is expected that members will participate in a value study in the following ways:
  - Participate in all meetings;
  - Collect the requested information;
  - Analyze the information;
  - Identifies the functions;
  - Contribute with ideas;
  - Evaluate ideas based on their experience and expertise;
  - Develop alternatives;
  - Present the results.
- Responsibilities of team members:
  - Keep accurate notes as attributed by the team leader.
  - Consult the team leader on any issues that may make progress difficult.
  - Show respect during audiences.
  - The weight of the workload is the same whenever possible.
  - They are willing to admit when they do not know; but to strive for the answer. Do not be afraid to make mistakes.
  - Stay focused and follow the basic steps in solving problems and ask for help from the team leader to know which techniques may be most appropriate for a particular problem.
  - Do not waste time discussing unnecessarily and no leap; assesses everything after the meeting ends.
  - Understands the approach learning its purpose, including the reason for each step and applied technique.
  - Working together as a team. They do not force individual solutions but know how to accept them all. Do not forget it can be more than a solution to a problem.
  - They are good listeners, do not interrupt people and do not try to guess what people are going to say and what they think.
  - Gathers all the data of the problem - some objectives, some subjective. They have open mind and are not an obstacle. They have to be excited about the project and what they are doing.

- Do not try to take control of the team and make it as useful as possible. The leader already has the hard work to try to guide, control and coordinate the global effort.

- Team Leader

The leader of the value team will plan, guide, and facilitate the study of value. Other responsibilities are noted below. This individual is also expected to have many abilities and experience. To ensure that the team leader is trained and qualified to lead the team, this must be a Certified Value Specialist (CVS) certified by SAVE International, or equivalent.

- Responsibilities of Team Leader:
  - Ensure the correct application of the value methodology and follow the work plan;
  - Leads the team to the activities necessary to complete the pre-study, the value study and the stages after the completion of a value study;
  - Delegate appropriate responsibilities;
  - Plan the team meetings and prepare the agenda;
  - Keep the team focused on a specific topic;
  - Keep members of the team involved and the work to be done;
  - Collect team members together whenever possible and maintain team continuity.
  - It is a catalyst to keep the team moving and motivated. It's diplomatic, not a dictator. **(Value Standard and Body of Knowledge)**

3.3.Methods for analyzing and comparing alternatives and displaying results

The evaluation phase aims to reduce the large number of ideas generated during the investigation phase to a number of concepts that seem to promise to achieve the project objectives. During the assessment phase, those ideas obtained in the creative stage will be eliminated, which clearly have no meaning. Ideally in the analysis is organized in logical groups and analyzed according to project criteria, to identify the best combinations of ideas.

The evaluation stages of the alternatives are as follows:

a. Determining the evaluation criteria;
b. Evaluating ideas;
c. Comparative analysis;
d. Appreciation of alternatives;
e. Calculation of the total score for each alternative;
f. Estimating the cost of each alternative;
g. calculating the value fraction;
h. Select the alternative that offers the best total value

This stage of the evaluation process is laborious, requiring much time and energy. Criteria are already set, following evaluation of ideas one by one. Before the actual assessment, the idea to be evaluated is discussed by the value analysis team to understand how it can address the project. This may involve reviewing information, drawing up schemes, sketches, discussing the idea for a thorough understanding of the concept.

Once the concept is thoroughly understood, the team tests the idea from the point of view of the criteria. To this end, a form is made, the first column of which records the ideas to be evaluated. The following columns are for a limited number of criteria, for example five. The five "Criteria" columns preceding the "Advantages" rate the ideas according to the client's critical. These criteria differ from the project. Ideas are appreciated by a five-speed system with a maximum of +2 points and a minimum of -2 points. Value analysis team recommendations that receive the score of -2 points for any of the criteria should not be developed nor presented, due to the current serious problems. The appreciation system has the following form:

+2 Significant improvement
+1 Some improvement
0 No significant change
-1 Easy degradation
-2 Significant degradation

Once the ideas are judged from the point of view of the evaluator, and the results are passed to the Criteria columns, further advantages and disadvantages of the idea are identified, with two columns placed according to the Criteria as the specific place of registration. It is Listed the positive features of the concept under analysis. The list may include not only technical benefits, but also other considerations such as customer or user acceptability, likeness to other known products or processes, usage, risk, ease of implementation, etc.

Once the team members have highlighted all the positive concept ideas, their focus remains focused on identifying potential issues that the concept could create, listing all the negative aspects of the idea.

A lot of caution is recommended in dealing with ideas with negative aspects. The fact that there are some disadvantages of the idea should not lead to the automatic rejection of the idea that presents the negative traits. On the contrary, it is advisable to analyze the idea to cancel or at least reduce the inconvenience to a tolerable level, which leads to the improvement of the concept by reducing or eliminating the negative impact. Currently, the negative traits are of two types, people and technology.

With the evaluation of ideas based on criteria and benefits, the team is now ready to evaluate the ideas that deserve to be developed in the future. The full appreciation of ideas is based on an appreciation system that uses a scale of 1 to 10 with the following index of appreciation:

- 10 Technically feasible - the project will have a lot to gain. Significant cost and / or functional improvements.
- 9 Technically feasible - the project will be improved. There will be some cost and / or functional improvements.
- 8 Technically feasible - minor cost and / or functional improvements.
- 7 There may be some benefits for the project - but additional analysis will be needed to predict whether cost and / or functional improvements are possible.

- 6 Alternative approach - but without significant benefits. Possible design suggestion.
- 5 Cost reduction - with some loss in functional requirements
- 4 Questionable benefits
- 3 Too many unknown to continue
- 2 Significant disadvantage
- 1 Does not meet the project requirements.

On the basis of total appreciation, the ideas that have been well appreciated are selected and will continue to work on them.

3.3.1. Comparative analysis (Benchmarking)

Comparative analysis is the refinement of the best comparison of the ideas selected in the previous stage. Traditionally, the choice of an idea is made by comparing potential alternatives based on the subjective judgment of the weight of the criteria and the risks. In this case, a particular criterion overwhelms the others, and the final decision is not the best choice for the company and the client. (20)

Management needs an assessment of the alternatives made objectively, from the point of view of all the criteria, to make the best decision. In response to this need, analysts are addressing this choice by using comparative analysis, which compares potential alternatives based on a mathematical approach, called matrix analysis, which reduces the subjectivity of assessing the weight of criteria and risks. In addition, benchmarking is able to combine benefits, assess the mix of resources, compare potential implementation alternatives, of great interest to management.

This matrix has been refined to evaluate mixed-action alternatives to all important criteria in the definition of value (the ratio of performance, delivery and cost) to making the best final decision. Matrix is a very effective tool for evaluating alternatives, as it can incorporate various criteria such as reliability, customer needs, quality, implementation requirements in the final recommendations. This approach can provide management with complex information to help them with the final decision.

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[20]. Carean M., Analiza valorii proiectelor. Suport de curs. Cluj -Napoca, 2010.

Exempul nr 1:

How important

2 Points for Major Preference

1 Point for Minor Preference

1 Point each for the same preference

	External Wall Functions								
A.	**Basic function: isolate a place**	**A**							
B.	**Secondary function: illuminate a space**	AB	**B**						
C.	**Secondary function: resist loads**	A1	B1	**C**					
D.	**Secondary function: Enhance the project**	A1	B1	D1	**D**				
E.	**Secondary function: place things**	A1	B1	CE	D1	**E**	**ΣF**	**C**	**V = ΣF / C**
	Levels of importance	5	5	2	3	2	Criteria weighted	LCC euro	Value Index
	Alternatives %	29	29	12	18	12			
1	External stone walls	**2**	**2**	**5**	**4**	**4**			
	(Rate) X (%)	**58**	**58**	**60**	**72**	**48**	**296**	**599,052**	**0.494**
2	Walls of glass resistant to fire	**4**	**5**	**2**	**4**	**2**			
	(Rate) X (%)	**116**	**145**	**24**	**72**	**24**	**381**	**631,622**	**0.603**
3	Walls of brick isolated + PVC Thermopan	**4**	**3**	**3**	**3**	**2**			
	(Rate) X (%)	**116**	**87**	**36**	**54**	**24**	**317**	**328,084**	**0.966**

Rates: (5) Excellent, (4) Very good, (3) Good, (2) Acceptable, (1) Poor

Figure 3.3. Comparative analysis method

♣ Determining Performance Criteria (Step 1)

The first step is recognizing and defining needs. Often decisions are made on products and services according to what the organization knows to design and produce, instead of considering customer needs. This leads to a decrease in the value of products or services and leads to losses. In the business. Determining the performance criteria involves gathering information across the organization, but also obtaining information from customers, so it is necessary to market research to determine the factors and traits demanded by customers.

♣ Determining the relative importance of each criterion (step 2)

There are two important steps to get the final result, namely selecting the criteria and then determining the relative weight (importance) of these criteria. Of these, the selection of criteria raises the least problems. With the help of various management sources, it is possible to decide which criteria should be used for internal reasons, and market research can highlight what features the customer wants. The fundamental question is, "How important is each criterion in relation to the other?" For example, for product design, essential criteria can be considered reliability, weight, performance, operation. For manufacturing, the criteria could be ease of production and quality. Marketing, appearance, delivery, maintenance can count. It is essential to determine the relative importance of the factors.

Is the reliability twice as important as weight? Is delivery half as important as quality? Is it easy to produce equal appearance?

Although there are various approaches that can be used to determine the weighting factor, the pairing method is one of the most effective. The method is based on the following working principle: "The simplest and less emotional decision takes only two criteria at once and determines which is the most important criterion in this pair. In fact, it is only necessary to answer the question "Is Criterion More Important than Criterion B?" Without the need to determine "Is the Criterion A Criterion B Important?" This compares each criterion with all others, easily determining the relative importance of each criterion.

To accomplish this, a pairing matrix is used. Let us consider a matrix, also referred to as "a", "b", "c", etc. In the pair box, the criterion considered by the value analysis team to be the most important of the pair analyzed is passed. The number of selections for each criterion is determined by the number of times a, b, c, etc. have appeared. across the matrix. This number is passed to the line of that criterion, under the Total heading. Then, the percentage of participation of each criterion in the total of decisions, ie the weighting of the criterion, is calculated. One criterion will always have a score of 0. This does not mean that the criterion has zero significance, but is the least important of all, and alternatives have to meet a minimum acceptability level for this criterion.

When using this technique, it is essential that decision-making takes into account the customer's opinion on their criteria and relative importance. This will help the team avoid the mismatches between the manufacturer and the customer.

Exemplu nr 2

			A	B	C	D	E
A.	Basic function: isolate a place	A	1	1	0	0	0
B.	Secondary function: illuminate a space	B	1	1	0	0	0
C.	Secondary function: resist loads	C	1	1	1	1	1
D.	Secondary function: Enhance the project	D	1	1	0	1	0
E.	Secondary function: place things	E	1	1	1	1	1
	Levels of importance	Total	5	5	2	3	2

Figure 3.4. Determining the level of importance of functions

3.3.2. Brainstorming (Osborn Method)

"Brainstorming" is a method that belongs to Alex Osborn and is a creative meeting based on the following principles:

a. postponement of criticism;
b. issuing as many ideas as possible;
c. encouraging "strange " ideas;
d. give your freedom to imagination.

These principles are written on the board of the hall in which the meeting takes place. The brainstorming essence consists in deliberately separating the act of imagination from the critical, objective, rational thinking phase. Hence, the method has also acquired the name of "delayed evaluation" or "suspension of evaluation". The method is also called the "philosophy of the great yes". The method proposes creating the conditions for stimulating the creativity of a group of specialists who are asked to participate in finding a solution to a particular problem. It is based on the results of psychological research on individual behavior in relation to a group of people who are debating a problem and is about to make a decision.

The method is based on the belief that a number of good ideas will be found in a large number of ideas. Brainstorming is not a technique for resolving unequal problems, but only an incentive for intuitive thinking in the sense of formulating ideas and solutions, in a larger number. Brainstorming does not end the creation process but just sketches it. The higher number of ideas and the more likely it is to have a valuable idea. Participants in the debate must be convinced that a given idea, even if at the moment it has nothing to do with the stated problem, may present an inspiration for other ideas and should not be ignored. A solution idea should not be supported with too many arguments. The brainstorming group should include:

a. Leader;

b. 1-2 secretaries;

c. 4-5 brainstorming specialists;

d. 4-5 specialists in the problem.

The optimal length of a session is 30-45 minutes. In value management brainstorming is used to:

a. establishing and formulating the functions of the project;

b. for the economic dimensioning of functions;

c. to reconsider the project.

Applying the method involves the following steps:

- ❖ Prepare of the meeting

It consists of determining the subject and selecting the participants. For each meeting a single subject is discussed. An invitation is invited to the members of the chosen team, specifying the issue, the day, the time and the meeting venue. This creates the premises for carrying out an incubation process, triggering associations. Those individuals were chosen earlier, aiming to be part of the various professions, thus ensuring a variety of points of view. These specialists take note of the problem, but do not analyze it specifically. The following conditions must be met in group formation:

- the selection is made according to the person's wish to attend the meeting;
- there should be no antipathy between the members of the group, against the relations of sympathy and friendship are preferable. In the same group do not be an administrative head with subordinates.

- ❖ Fulfilling the meeting

At the beginning of the meeting, the team leader presents the subject clearly and succinctly (subject to debate). Day and time should be chosen so that participants are not tired or under the influence of events that affect their mood. The leader can stop the group's activity to trigger some individual focus concentration. Ideas will not receive the author's name.

- ❖ Selection ideas

It takes place after the meeting, by one or more people who evaluate the value of different ideas. The group secretary prepares a list of all the ideas. The list is typed with spaces between proposals. The selection of ideas is done by a dedicated team. In evaluating ideas, the following questions are useful:

- Is the idea simple enough?
- Is the idea acceptable from a human point of view?
- Is the idea opportune?
- Is it feasible?
- Can it help increase productivity?
- Will the costs decrease?

If the chosen variant does not show any changes in the value of use compared to the existing version, only the costs will be assessed. The best variants remaining in the selection must be analyzed in terms of when they can be achieved. The results of the study are synthesized in a final report, which will serve to support the proposals. It must include:

- description of the optimal variant;
- establishing tasks and responsibilities;
- presenting the risks to the solution chosen and proposals for their avoidance.

3.3.3. The Pareto Method (A. B. C.)

The Pareto method is also known as A,B,C or 20/80. It is a method of programming, selecting, analyzing and grouping the contribution of the components of a researched system that allows decisions to be made according to their weight in the analyzed effect. The Pareto method is a method of research efficiency that selects the relevant causes of a phenomenon. In a product, not all landmarks have the same contribution to price formation. Usually a small number of landmarks, 2-3, deserve special attention in terms of cost, and we need to focus our efforts on them. [(21)]

The method consists in dividing the ensemble (the number of repre- sentations) into a number of groups. The criterion of division can be: the workload, the amount of material, the amount of energy, etc. The number of groups in which the ensemble is divided may be any natural number, but the most frequently used figure is 3.

So we will divide an assembly, from the point of view of the amount of energy required for processing into three groups (A, B, C):

- Group A - contains a small number (typically 20%) of landmarks that require a large amount of energy to process;

- Group B - contains an average (usually 30%) of landmarks that require a large amount of energy to process;

- Group C - contains a large number (typically 50%) of landmarks that require a large amount of energy to process.

The Pareto method is also known as "A,B,C method". Instead of 20.30%, other combinations can be used, such as 5, 20, 75%.

Example 1:

In Figure 3.6 we present an example of a Pareto diagram for a product in terms of labor consumption. She is of type 50, 40, 10.

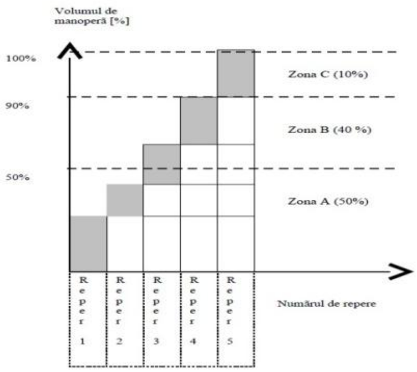


Figure 3.6. Pareto Diagram

(21). Managementul si Ingineria valorii, CHIRCOR Mihael, Editura Universitatea "Ovidius" Constanta,2002.

In value engineering studies, the Pareto method has applications in the economic sizing stage of functions and product reconciliation. For example, when determining function costs, it is not necessary to consider all the parts or operations, but only those of the representative in terms of weight in the total cost. The economic dimension is sufficiently precise, if only the benchmarks are considered, the representative subassemblies.

Reconstruction of the product can be achieved quickly and efficiently by using the concepts of the Pareto method. Instead of reconstituting all functions, it is enough to recreate only the functions with the largest economic over-dimensioning. Also, when reconfiguring a function, it is enough to stop at the benchmark with the largest share in the cost of the function.

Exemplu nr 2

No.	Activities name	U.M	quantity	Price (sp)	Price (euro)	Total price (euro)	Cumulative cost	percent %	Cumulative percent%
1	Reinforced concrete (C20 / 25) with brick for slab and beams	mc	1,500	6,775.00	104.23	156,346.15	156,346	43%	43%
2	Reinforced concrete (C20 / 25)	mc	900	8,195.00	126.08	113,469.23	269,815	31%	74%
3	External walls made of marble (30x20x3) cm	mc	600	4,740.00	72.92	43,753.85	313,569	12%	86%
4	Excavations mechanically (including leveling, grading manipulation)	mc	3,500	350.00	5.38	18,846.15	332,415	5%	91%
5	Internal walls of brick (40x20x15) cm	mc	215	2,390.00	36.77	7,905.38	340,321	2%	93%
6	Simple concrete for the floor (B200), 12/15 thick 10 cm	mc	120	4,230.00	65.08	7,809.23	348,130	2%	96%
7	Simple concrete C12 / 15 with stone	mc	200	1,980.00	30.46	6,092.31	354,222	2%	97%
8	Simple concrete under the foundation (B200), 12/15	mc	125	2,260	34.77	4,346	358,568	1%	98%
9	Yellow ornamental stone 10 cm thick and 30 cm wide	m	500	395	6.08	3,038	361,607	1%	99%
10	Leveling and compacting stone in layers of 25 cm thick	mc	850	130	2.00	1,700	363,307	0%	100%
11	Leveling and compacting gravel in layers of 15 cm thick	mc	200	275	4.23	846	364,153	0%	100%

Figure 3.7. Pareto diagram

CHAPTER 4: Case Study

Investment and commercial complex (MALL)in Aleppo, Syria

4.1.General project information

The project is the investment complex located in Aleppo, Syria. The hypothetic age of the project is 30 years.

The building of the project consists of:

- Basement has landfills, central heating, electricity, water meters and a range of shops.
- The ground floor has two entrances and sub-prime and drawers, elevators and shops and services.
- Three floors in each of which several business stores with the necessary services, the fourth floor is several service offices.
- Restaurant on the roof.

Figure 4.1. investment complex

4.1.1. Project spaces

Floor	Shop spsces (M²)	Corridor spaces (M²)	Total Area (M²)
Basement	556.99	703.01	1260
Ground	631.49	628.51	1260
1st floor	689.53	570.47	1260
2nd Floor	689.53	570.47	1260
3rd floor	676.01	583.99	1260
Restaurant	690	570	1260
Total	3933.55	3626.45	7560

Table 4.1. project areas

4.1.2. The Cost of project

Name of activity	Total price (s.p)	Total price (€)	Percent%
Construction works	23,669,950	364,153	31%
Architectural works and finishes	30,064,924	462,537	39%
Electrical works	9,553,535	146,977	12%
Mecanical works	13,488,580	207,517	18%
Total	76,776,989	1,181,184	100%

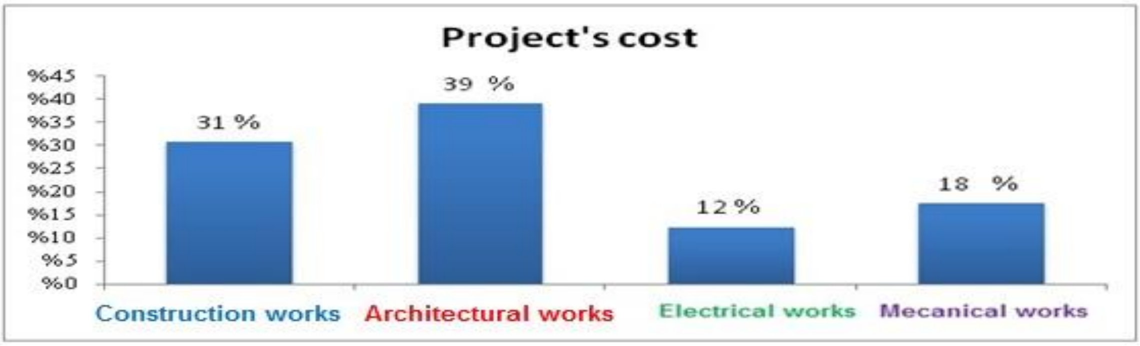


Table 4.2. Project's cost

4.2.Phases of value engineering on the project

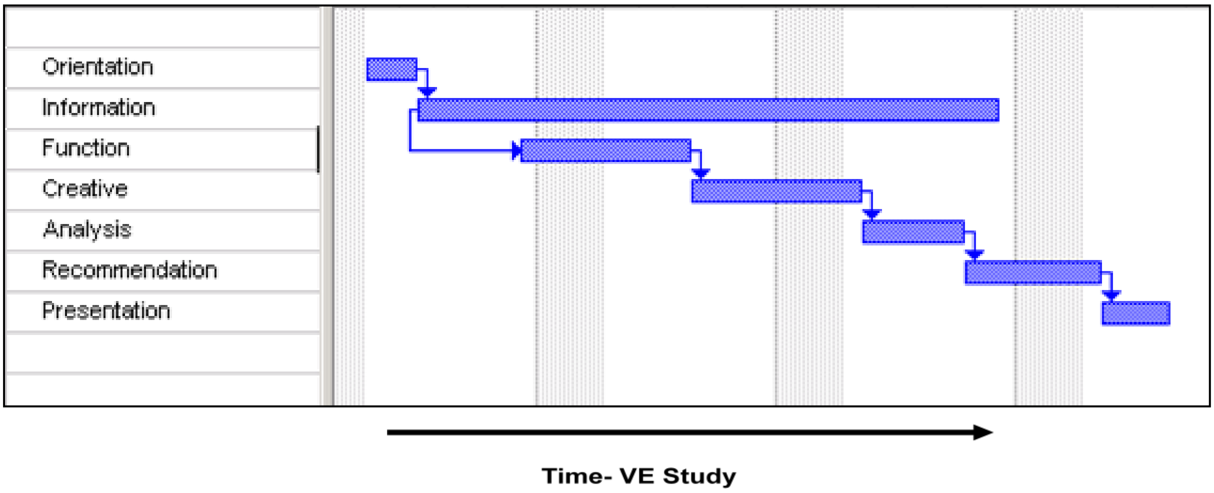


Figure 4.2. Phases of value engineering

4.2.1. Preparatory measures

- The purpose of the case study

  Through the value engineering methodology, we will redesign the project to improve the quality and function of the project and eliminate unnecessary costs.
- Value engineering team

  Before we start analyzing, we need to form a technical team that has the following engineers:
- Team Leader (CVS)
- Constructor
- Architect engineer
- Installation engineers (electrician, mechanic, sanitary)
- Owner

- Contractor
- Investor

4.2.2. Information phase

Through the designing company we have collected the architectural, constructor, electrical, mechanical and sanitary plans and specification. We set the following points:

- Name and purpose of the project: Investment and Commercial Complex
- Owner: ALEPPO City Hall
- Designer: SYRIAN DESIGN COMPANY
- Contractor: SYRIAN NATIONAL COMPANY
- Consultant: CONSULTANT ENGINEERING CENTER
- Investor: ALEPPO SY COMPANY
- Project place: Aleppo, Syria
- Duration of project execution: 6 months
- Total area: 7560 m2
- Cost of construction works: 1,181,184 euros

Quality flower of project

It represents the important criteria and specifications of the project. The Value Engineering team analyzed the general project information and gave notes to the criteria shown in Table 4.3:

The scop of value engineering opens flower the largely by raising the project criteria notes and this scop is achieved at the end of the study.

No.	criteria	mark
1	motion through the project	6
2	the form of interfaces	6
3	the location of the project	7
4	safety	5
5	energy consumption	4
6	spaces	5
7	the initial cost	5
8	function of the program	6
9	future extension	5
10	neighborhood	6
11	duration of execution	7
12	operating costs	4
13	parking	5
14	environmental impact	5
15	construction method	5
16	area development	10
17	the light	7
18	ventilation	6

Table 4.3. criteria of project

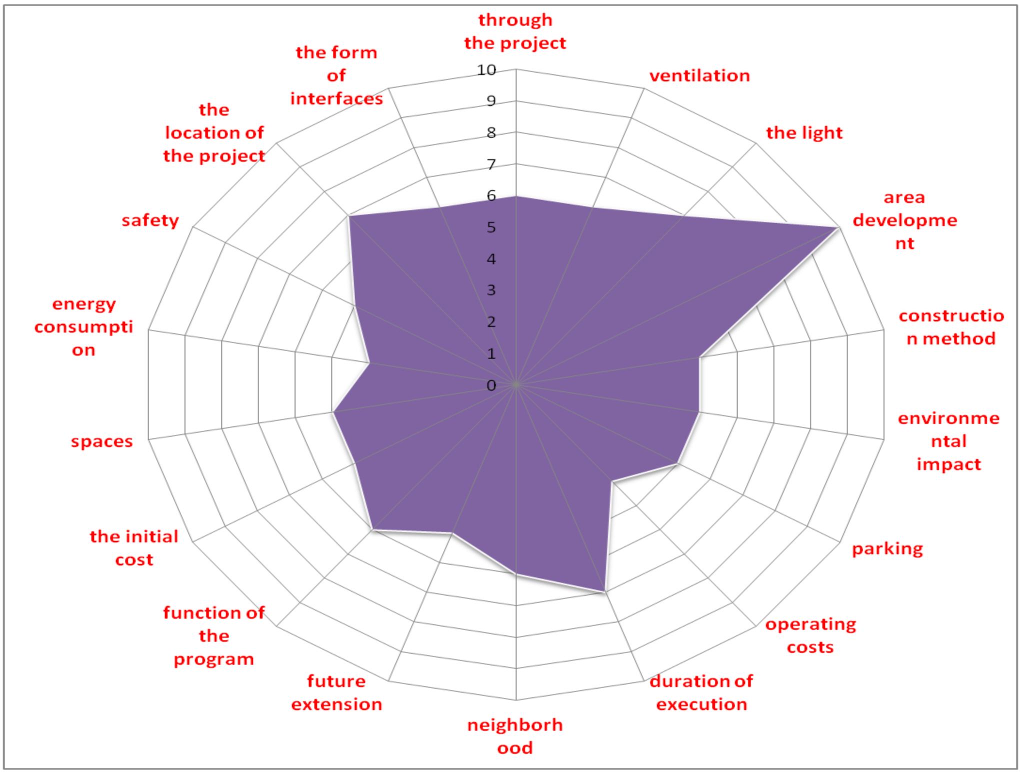


Figure 4.3. quality flower

- FAST Diagram

Functional Analysis System Technique Diagram, Shows specific relationships between all project functions, helps to identify the mission of functions and project scop and increases the knowledge about the needs of project participants and all members of the value analysis team as see in figure 3.1, p. 25.

4.2.3. Function analysis

When we want to analyze the works and functions of the project using the traditional method, it takes a long time. Because we have a lot of costs and works, that's why we used the Pareto method to analyze all project costs.

A. Applying Pareto on construction works

No.	Activities name	U.M	quantity	Price (sp)	Price (euro)	Total price (euro)	Cumulative cost	percent %	Cumulative percent%
1	Reinforced concrete (C20 / 25) with brick for slab and beams	m³	1,500	6,775.00	104.23	156,346.15	156,346	42.9%	43%
2	Reinforced concrete (C20 / 25)	m³	900	8,195.00	126.08	113,469.23	269,815	31.2%	74%
3	External walls made of marble (30x20x3) cm	m³	600	4,740.00	72.92	43,753.85	313,569	12.0%	86%
4	Excavations mechanically (including leveling, grading manipulation)	m³	3,500	350.00	5.38	18,846.15	332,415	5.2%	91%
5	Internal walls of brick (40x20x15) cm	m³	215	2,390.00	36.77	7,905.38	340,321	2.2%	93%
6	Simple concrete for the floor (B200), 12/15 thick 10 cm	m³	120	4,230.00	65.08	7,809.23	348,130	2.1%	96%
7	Simple concrete C12 / 15 with stone	m³	200	1,980.00	30.46	6,092.31	354,222	1.7%	97%
8	Simple concrete under the foundation (B200), 12/15	m³	125	2,260	34.77	4,346	358,568	1.2%	98%
9	Yellow ornamental stone 10 cm thick and 30 cm wide	m	500	395	6.08	3,038	361,607	0.8%	99%
10	Leveling and compacting stone in layers of 25 cm thick	m³	850	130	2.00	1,700	363,307	0.5%	100%
11	Nivelare și compactare pietriș în straturi de 15 cm grosime	m³	200	275	4.23	846	364,153	0.2%	100%

Table 4.4. construction works

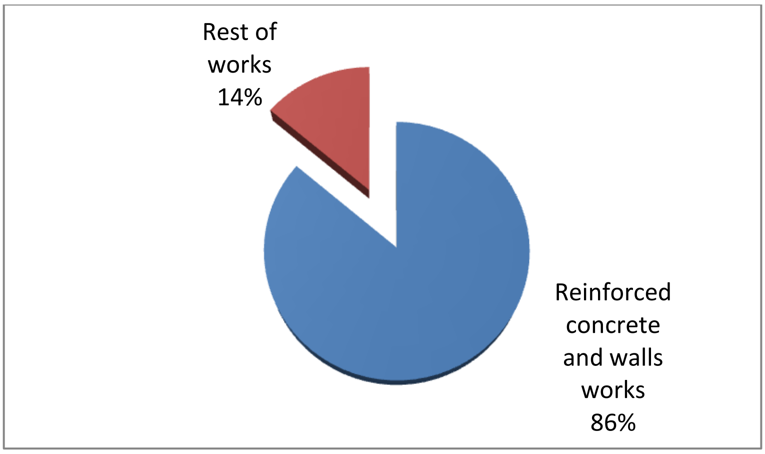


Figure 4.5. Pareto for construction works

B. Applying Pareto on Architectural and finishing works

No.	Activities name	U.M	quantity	Price (sp)	Price (euro)	Total price (euro)	Cumulative cost	percent %	Cumulative percent%
1	Windows from PVC	m²	1,455	8,400	129.23	188,031	188,031	41%	41%
2	Marble floor and tiles of 40 * 40 cm	m²	4,510	1,085	16.69	75,282	263,313	16%	57%
3	Installation walls and windows interior of glass	m²	1,080	2,750	42.31	45,692	309,005	10%	67%
4	Painting the walls in three layers	m²	18,850	145	2.23	42,050	351,055	9%	76%
5	Installation doors of iron	m²	1,080	2,500	38.46	41,538	392,594	9%	85%
6	Installation doors of wooden	m²	245	3,000	46.15	11,308	403,902	2%	87%
7	Ceramics works	m²	975	640	9.85	9,600	413,502	2%	89%
8	Tiles and marble work	m²	4,000	120	1.85	7,385	420,886	2%	91%
9	Thermal and sound insulation of 3 mm roof from bitumen	m²	2,400	195	3.00	7,200	428,086	2%	92%
..									
..									
30									100%

Table 4.5. Pareto for Architectural and finishing works

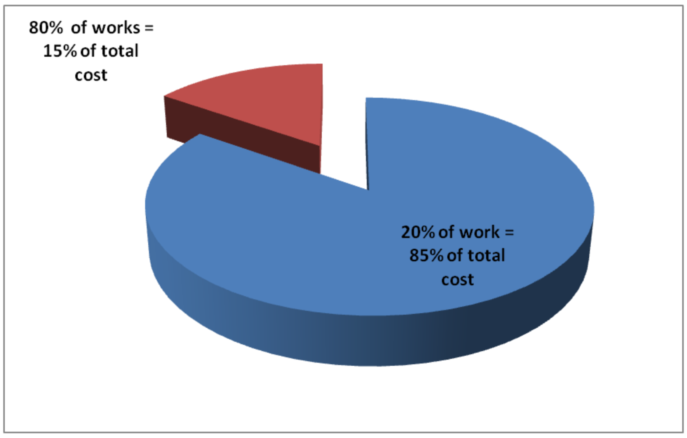
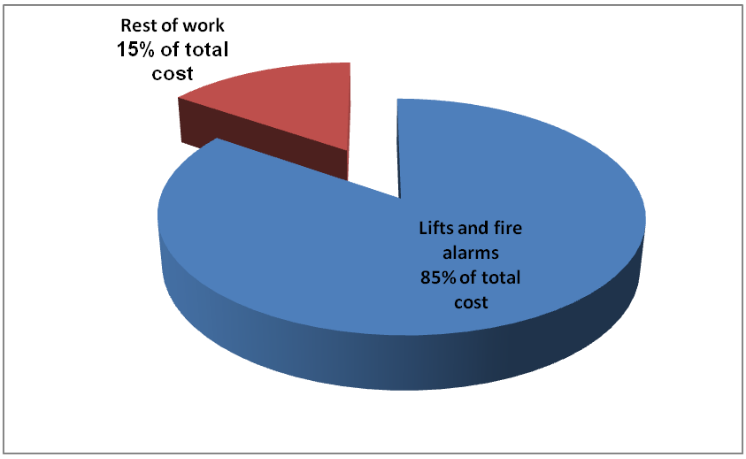


Figure 4.6. Pareto for Architectural and finishing works

C. Applying Pareto for electrical works

No.	Activities name	U.M	quantity	Price (sp)	Price (euro)	Total price (euro)	Cumulative cost	percent %	Cumulative percent%
1	Mounting a fire alarm	piese	126	29,000	446	56,215	56,215	38%	38%
2	Mounting a lift with a load of 6 people	piese	2	1,000,000	15,385	30,769	86,985	21%	59%
3	Mounting elevator with a load of 10 people	piese	1	1,350,000	20,769	20,769	107,754	14%	73%
4	Mounting electrical panel for offices and shopsType TO	piese	124	5,770	89	11,007	118,761	7%	81%
5	Mounting of electrical outlets	piese	550	670	10	5,669	124,430	4%	85%
6	Mounting general building panel for the building Type TH	piese	1	317,000	4,877	4,877	129,307	3%	88%
7	Installation of fluorescent tube (2 × 40) with all necessary accessories	piese	360	870	13	4,818	134,126	3%	91%
8	Install and connect the main cables Type NYY	m	800	215	3	2,646	136,772	2%	93%
..									
..									
28									100%

Table 4.6. electrical works

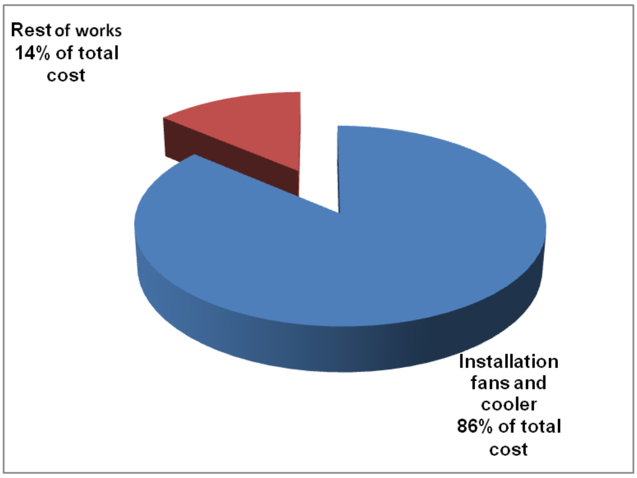


Figuara 4.7. Pareto for electrical works

D. Applying Pareto on mechanical works

No.	Activities name	U.M	quantity	Price (sp)	Price (euro)	Total price (euro)	Cumulative cost	percent %	Cumulative percent%
1	Installation fans with accessories	piece	145	40,500	623	90,346	90,346	44%	44%
2	Cooler installation with a capacity of 50 x 9,000 BTU / h	piece	3	1,920,000	29,538	88,615	178,962	43%	86%
3	installation of heating boiler with maximum capacity 350000 kcal / h	piece	2	532,440	8,191	16,383	195,344	8%	94%
4	Mounting and installing Techno BCS pipelines with all the required 1 inch pieces and accessories	ml	3,750	110	2	6,346	201,690	3%	97%
5	Mounting the PSI cabinet with all necessary parts and accessories	piece	10	36,000	554	5,538	207,229	3%	100%
6	Mounting and installing the Technogreen pipes with all 3 inch pieces and accessories required	ml	275	68	1	288	207,517	0%	100%

Table 4.7. mechanical works



Figuara 4.8. Pareto for mechanical works

4.2.4. Investigation phase

After analyzing the cost of the project with Pareto's method, the value engineering team created the new ideas or optimal solutions such as:

- **Construction works**
  - Improve and increase reinforced concrete strength of 200 kg / cm^2 to 250 kg / cm^2 .
  - Reducing static loads by replacing hollow block slabs with HOLLOW-CORE slabs (base hollows) and outer stone walls on exterior walls insulated with expanded polystyrene.

Figure 4.9. Types of brick and slabs

- Exact and detailed calculation of the concrete quantities of the project.
- Analyze and calculate the price of reinforced concrete after calculating the percentage of steel in reinforced concrete.

♣ **Architectural and finishing works**
- Calculation and optimal use of project spaces.
- Improve the spaces of project.

♣ **Electrical works**
- Using low-power LED lamps.

♣ **Mechanical works**
- Use of solar energy technology to ensure energy consumption.
- Re-calculating the energy needs of the building after changing the exterior walls and the number of fans and coolers it needs.

4.2.5. Evaluation phase

❖ **Construction works**
- Evaluation of slabs types

Reinforced concrete slab			Hollow Block Slab		
Works for m³	Price (sp)	Price (euro)	Works for m³	Price (sp)	Price (euro)
cement with transport 350 kg / m3	2450	37.69	cement with transport 350 kg / m3	1428	21.97
gravel and sand	200	3.08	gravel and sand	150	2.31
steel (130)kg/mc	3510	54	steel (100)kg/mc	2700	42
black wire for tying	25	0.38	black wire for tying	45	0.69
water	25	0.38	water	25	0.38
formwork and casting (carpenter, concrete worker, workers)	700	10.77	formwork and casting (carpenter, concrete worker, workers)	800	12.31
			brick with transportation	500	7.69
indirect cost and profit	1285	19.77	indirect cost and profit	1291	19.86
Total	8195.00	126.08	Total	6939	106.75
Concrete slab with expanded polystyrene			**HOLLOW CORE Slab**		
Works for m³	Price (sp)	Price (euro)	Works for m³	Price (sp)	Price (euro)
cement with transport 350 kg / m3	1428	21.97	concrete with transportation	7000	107.69
gravel and sand	150	2.31			
steel (100)kg/mc	2700	42			
black wire for tying	45	0.69			
water	25	0.38			
formwork and casting (carpenter, concrete worker, workers)	800	12.31			
expanded polystyrene	800	12.31			
indirect cost and profit	1291	19.86	indirect cost and profit	1300	20.00
Total	7239.00	111.37	Total	8300.00	127.69

Table 4.8. Cost Analysis of slab

			A	B	C	D	E
A.	**Basic function: resist loads**	A	1	1	0	0	0
B.	**Secondary function: isolate a place**	B	1	1	0	0	0
C.	**Secondary function: delimit the floors**	C	1	1	1	1	1
D.	**Unwanted function: increase loads**	D	1	1	1	1	1
E.	**Secondary function: facilitate execution**	E	1	1	1	1	1
	Levels of importance	Total	5	5	3	3	3

Table 4.9. Matrix of the level of importance of functions

How important

2 Points for Major Preference

1 Point for Minor Preference

1 Point each for the same preference

	Functions of slabs								
A.	**Basic function: resist loads**	**A**							
B.	**Secondary function: isolate a place**	AB	**B**						
C.	**Secondary function: delimit the floors**	A1	B1	**C**					
D.	**Unwanted function: increase loads**	A1	B1	CD	**D**				
E.	**Secondary function: facilitate execution**	A1	B1	CE	DE	**E**	**ΣF**	**C**	**V = ΣF / C**
	Levels of importance	5	5	3	3	3	Criteria weighted	LCC euro	Value Index
	Alternatives %	26	26	16	16	16			
1	Concrete slab with expanded polystyrene	**4**	**5**	**4**	**4**	**3**			
	(Rate) X (%)	**104**	**130**	**64**	**64**	**48**	**410**	**111.4**	**3.68**
2	HOLLOW-CORE Slab	**5**	**4**	**5**	**5**	**5**			
	(Rate) X (%)	**130**	**104**	**80**	**80**	**80**	**474**	**127.7**	**3.71**
3	Reinforced concrete slab	**4**	**3**	**4**	**5**	**4**			
	(Rate) X (%)	**104**	**78**	**64**	**80**	**64**	**390**	**126.1**	**3.09**
4	Hollow Block Slab	**4**	**4**	**4**	**4**	**3**			
	(Rate) X (%)	**104**	**104**	**64**	**64**	**48**	**384**	**106.8**	**3.60**

Rates: (5) Excellent, (4) Very good, (3) Good, (2) Acceptable, (1) Poor

Table 4.10. The matrix of evaluating alternatives of slabs

- Analysis and calculation of the price of reinforced concrete after calculating the percentage of steel in reinforced concrete

Price analysis for one cubic meter of reinforced concrete					
Before improving the concrete strength			After improving the concrete strength		
Works for m³	Price (sp)	Price (euro)	Works for m³	Price (sp)	Price (euro)
cement with transport 350 kg / m³	2450	37.69	cement with transport 400 kg / m^3	2950	45.38
gravel and sand	200	3.08	gravel and sand	200	3.08
steel (130)kg/m^3	3510	54	steel (80)kg/m^3	2160	33.23
black wire for tying	25	0.38	black wire for tying	25	0.38
water	25	0.38	water	25	0.38
formwork and casting (carpenter, concrete worker, workers)	700	10.77	formwork and casting (carpenter, concrete worker, workers)	700	10.77
indirect cost and profit	1285	19.77	indirect cost and profit	1285	19.77
Total	8195	126.08	Total	7345	113.00

	U.M	Columns	Foundations
The exact amount of concrete	m³	530	346
The exact amount of steel	kg	56,405	10,055
percent kg/m³	kg/m³	76	
Total quantity	m³	876	
Old price	euro	126.08	
New price	euro	113.00	
Total money saved	euro	11,457.00 €	

Table 4.11. Price analysis for m³ of reinforced concrete

- Improve and increase reinforced concrete strength of 200 kg / cm^2 to 250 kg / cm^2

	U.M	Columns	Foundations
The exact amount of concrete	mc	530	346
Discount percentage	%	19%	19%
Quantity saved	mc	100.7	65.7
Price (sp)	sp	7345	7345
Price (euro)	euro	113.00 €	113.00 €
Total money saved	euro	11,383.89 €	7,426.48 €
		18,810.37 €	

Table 4.12. Saving of reinforced concrete

- Reduction of static loads by replacing brick slabs with HOLLOW-CORE (empty base) and exterior stone walls with isolated exterior walls:

	U.M	Beams	Columns	Foundations
The exact amount of concrete	m³	70	530	346
Discount percentage	%	3%	9%	9%
Quantity saved	mc	2.11	47.72	31.13
Price (euro)	euro	104.26 €	113.00 €	113.00 €
Total money saved	euro	219.83 €	5,392.37 €	3,517.81 €
			9,130.00 €	
The exact amount of steel	kg	133583	56405	10055
Discount percentage	%	17%	17%	17%
Quantity saved	kg	22709.11	9588.85	1709.35
Price (euro)	euro	0.42 €	0.42 €	0.42 €
Total money saved	euro	9,433.01 €	3,983.06 €	710.04 €
			14,126.11 €	

Table 4.13. Saving after reducing static loads

The savings made after the improvement of concrete strength	euro	11,457.00 €
	euro	18,810.37 €
Savings made after static load reduction	euro	9,130.00 €
	euro	14,126.11 €
Total save	euro	53,523.49 €
Total cost of reinforced concrete	euro	269,815.38 €
Total saving percent	%	19.8%

Table 4.14. Total saving for construction works

- **Architectural and finishing works**

Calculation and optimal use of project spaces of stores will earn revenue by investing between these stores and the revenue from this investment will be more when the space is bigger. Changing design and increasing mezzanine spaces leading to:

- Increasing the percentage of lighting and providing better ventilation;
- Exploitation of the spaces better, we put a small cafeteria in the basement;
- Reduction of construction and energy costs;
- Organize customer traffic.

projects spaces		
stores	m^2	2567.54
corridors	m^2	3200.45
offices	m^2	676.01
restaurant	m^2	1063
Total		7507

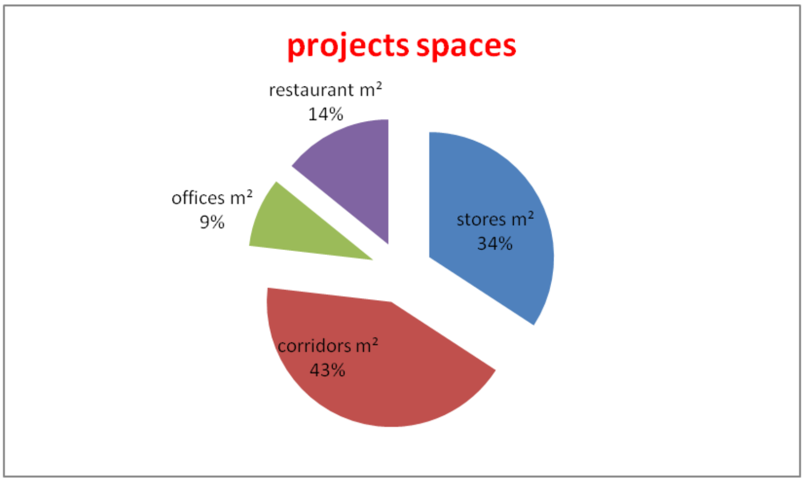


Table 4.15. Projects spaces

	Project income after changing spaces and design			
	Before the change		After the change	
Activities	Annual income (sp)	Annual income (euro)	Annual income (sp)	Annual income (euro)
Restaurant	39,945,840	614,551.38	39,945,840	614,551.38
Stores	11,655,804	179,320.06	12,699,360	195,374.77
Offices	4,056,060	62,400.92	4,361,460	67,099.38
Total	55,657,704	856,272.37	57,006,660	877,025.54
percent %		2.4%		

Table 4.16. Project income after changing spaces and design

Figure 4.10. Plans after the change

- Evaluating the types of exterior walls

			Walls of brick isolated + PVC Thermopan					
year	Present value rate	Initial cost	Costul de întreținere	Cost of operation	The cost of energy	The present value (sp)	The present value (euro)	LCC
0	1.00	13,640,000				13,640,000	209,846.15	
1	0.93		110,000	100,000	472,680	632,111	9,724.79	
2	0.86		110,000	100,000	472,680	585,288	9,004.43	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
29	0.11		110,000	100,000	472,680	73,270	1,127.24	
30	0.10		110,000	100,000	472,680	67,843	1,043.74	
								328,084

			External wall from glass resistant to fire					
year	Present value rate	Initial cost	Costul de întreținere	Cost of operation	The cost of energy	The present value (sp)	The present value (euro)	LCC
0	1	12,222,000				12,222,000	188,030.77	
1	0.93		50,000	50,000	2,461,200	2,371,481	36,484.33	
2	0.86		50,000	50,000	2,461,200	2,195,816	33,781.79	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
29	0.11		50,000	50,000	2,461,200	274,887	4,229.03	
30	0.10		50,000	50,000	2,461,200	254,525	3,915.77	
								631,622

			External stone walls					
year	Present value rate	Initial cost	Costul de întreținere	Cost of operation	The cost of energy	The present value (sp)	The present value (euro)	LCC
0	1.00	9,832,500				9,832,500	151,269.23	
1	0.93		62,100	62,100	2,461,200	2,393,889	36,829.06	
2	0.86		62,100	62,100	2,461,200	2,216,564	34,100.98	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
29	0.11		62,100	62,100	2,461,200	277,485	4,268.99	
30	0.10		62,100	62,100	2,461,200	256,930	3,952.77	
								599,052

Table 4.17. The present value of the alternatives of the exterior walls

	External Wall Functions	A	B	C	D	E	ΣF	C	V = ΣF / C
A.	Basic function: isolate a place	A							
B.	Secondary function: illuminate a space	AB	B						
C.	Secondary function: resist loads	A1	B1	C					
D.	Secondary function: Enhance the project	A1	B1	D1	D				
E.	Secondary function: replace things	A1	B1	CE	D1	E			
	Levels of importance	5	5	2	3	2	Criteria weighted	LCC euro	Value Index
	Alternatives %	29	29	12	18	12			
1	External stone walls	2	2	5	4	4			
	(Rate) X (%)	58	58	60	72	48	296	599,052	0.494
2	Walls of glass resistant to fire	4	5	2	4	2			
	(Rate) X (%)	116	145	24	72	24	381	631,622	0.603
3	Walls of brick isolated + PVC Thermopan	4	3	3	3	2			
	(Rate) X (%)	116	87	36	54	24	317	328,084	0.966

How important

2 Points for Major Preference
1 Point for Minor Preference
1 Point each for the same preference

Rates: (5) Excellent, (4) Very good, (3) Good, (2) Acceptable, (1) Poor

Table 4.18. The matrix of evaluating alternatives of external wall

- Evaluating the types of interior walls

Classical brick walls

year	Present value rate	Initial cost	Costul de întreținere	Cost of operation	The cost of energy	The present value (sp)	The present value (euro)	LCC
0	1.00	3,247,106				3,247,106	49,955.48	
1	0.93		150,000	150,000	1,845,900	1,986,944	30,568.38	
2	0.86		150,000	150,000	1,845,900	1,839,763	28,304.05	
3	0.79		150000.00	150000.00	1845900.00	1703484.61	.	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
29	0.11		150,000	150,000	1,845,900	230,314	3,543.29	
30	0.10		150,000	150,000	1,845,900	213,254	3,280.83	
								421,618

Walls from Insulated brick with polystyrene

year	Present value rate	Initial cost	Costul de întreținere	Cost of operation	The cost of energy	The present value (sp)	The present value (euro)	LCC
0	1	6,450,000				6,450,000	99,230.77	
1	0.93		10,000	10,000	54,510	68,991	1,061.40	
2	0.86		10,000	10,000	54,510	63,880	982.77	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
29	0.11		50,000	50,000	2,461,200	274,887	4,229.03	
30	0.10		50,000	50,000	2,461,200	254,525	3,915.77	
								112,136

Walls made of gypsum-board composite panels

year	Present value rate	Initial cost	Costul de întreținere	Cost of operation	The cost of energy	The present value (sp)	The present value (euro)	LCC
0	1.00	4,039,250				4,039,250	62,142.31	
1	0.93		150,000	150,000	1,845,900	1,986,944	30,568.38	
2	0.86		150,000	150,000	1,845,900	1,839,763	28,304.05	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
.	.		.	.	.	.	.	
29	0.11		150,000	150,000	1,845,900	230,314	3,543.29	
30	0.10		150,000	150,000	1,845,900	213,254	3,280.83	
								433,805

Table 4.19. The present value of the alternatives of the interior walls

	Function of interior walls								
A.	Basic function: separates the space	A							
B.	Secondary function: isolate a place	AB	B						
C.	Secondary function: resist loads	A1	B1	C					
D.	Secondary function: beauty project	A1	B1	CD	D				
E.	Secondary function: hung things	A1	BE	CE	DE	E	ΣF	C	V = ΣF / C
	Levels of importance	4	4	2	2	3	Criteria weighted	LCC euro	Value Index
	Alternatives %	27	27	13	13	20			
1	Walls made of gypsum-board composite panels	5	4	2	5	2			
	(Rate) X (%)	135	108	26	65	40	374	433,805	0.862
2	Walls from Insulated brick with polystyrene	5	5	3	3	3			
	(Rate) X (%)	135	135	39	39	60	408	112,136	3.638
3	Classical brick walls	5	3	4	3	4			
	(Rate) X (%)	135	81	52	39	80	387	421,618	0.918
4	Red brick wall with vertical holes	5	4	4	3	4			
	(Rate) X (%)	135	108	52	39	80	414	317,068	1.306

How important

2 Points for Major Preference
1 Point for Minor Preference
1 Point each for the same preference

Rates: (5) Excellent, (4) Very good, (3) Good, (2) Acceptable, (1) Poor

Table 4.20. The matrix of evaluating alternatives of interior wall

- Evaluating types of floors and tiles

	Floor and tiles Functions								
A.	Basic function: beauty the floor	A							
B.	Secondary function: maintains the floor	A1	B						
C.	Secondary function: isolate a floor	AC	B1	C					
D.	Unwanted function: increase loads	A1	BD	C1	D				
E.	Secondary function: protect the floor	A1	BE	C1	DE	E	ΣF	C	V = ΣF / C
	Levels of importance	4	3	3	2	2	Criteria weighted	LCC euro	Value Index
	Alternatives %	30	21	21	14	14			
1	Italian marble tiles	5	4	4	4	4			
	(Rate) X (%)	150	84	84	56	56	430	93,643	4.592
2	Ceramic tiles	3	3	3	4	3			
	(Rate) X (%)	90	63	63	56	42	314	65,190	4.817
3	Natural granite tiles	5	4	5	2	4			
	(Rate) X (%)	150	84	105	28	56	423	104,056	4.065
4	Turkish marble tiles	5	4	4	4	4			
	(Rate) X (%)	150	84	84	56	56	430	86,704	4.959

How important

2 Points for Major Preference
1 Point for Minor Preference
1 Point each for the same preference

Rates: (5) Excellent, (4) Very good, (3) Good, (2) Acceptable, (1) Poor

Table 4.21. The matrix of evaluating alternatives of tiles

❖ Electrical works

- Use of normal electrical bulbs, economic bulbs and LEDs

		Traditional incandescent bulbs					
year	Present value rate	Initial cost	Costul de întreținere	Cost of operation	The present value (sp)	The present value (euro)	LCC
0	1.00	7,175			7,175	110.38	
1	0.93		1,435	413,280	277,297	4,266.10	
2	0.86		1,435	413,280	355,551	5,470.02	
.	.		.	.	.	.	
.	.		.	.	.	.	
.	.		.	.	.	.	
29	0.11		1,435	413,280	44,510	684.77	
30	0.10		1,435	413,280	41,213	634.05	
							70,296

		Economic Bulbs (Compact Fluorescent)					
year	Present value rate	Initial cost	Costul de întreținere	Cost of operation	The present value (sp)	The present value (euro)	LCC
0	1	57,400			57,400	883.08	
1	0.93		5,740	95,054	93,328	1,435.82	
2	0.86		5,740	95,054	86,415	1,329.46	
.	.		.	.	.	.	
.	.		.	.	.	.	
.	.		.	.	.	.	
29	0.11		5,740	95,054	10,818	166.43	
30	0.10		5,740	95,054	10,017	154.10	
							18,340

		LED bulbs					
year	Present value rate	Initial cost	Costul de întreținere	Cost of operation	The present value (sp)	The present value (euro)	LCC
0	1	229,600			229,600	3,532.31	
1	0.93		4,592	82,656	80,785	1,242.85	
2	0.86		4,592	82,656	74,801	1,150.79	
.	.		.	.	.	.	
.	.		.	.	.	.	
.	.		.	.	.	.	
29	0.11		4,592	82,656	9,364	144.06	
30	0.10		4,592	82,656	8,670	133.39	
							18,643

Tablul 4.22. The present value of the alternatives of bulbs

- **Mecanical works**
  - Recalculation the energy needs of the building after changing the exterior walls and the number of fans and coolers that it needs.

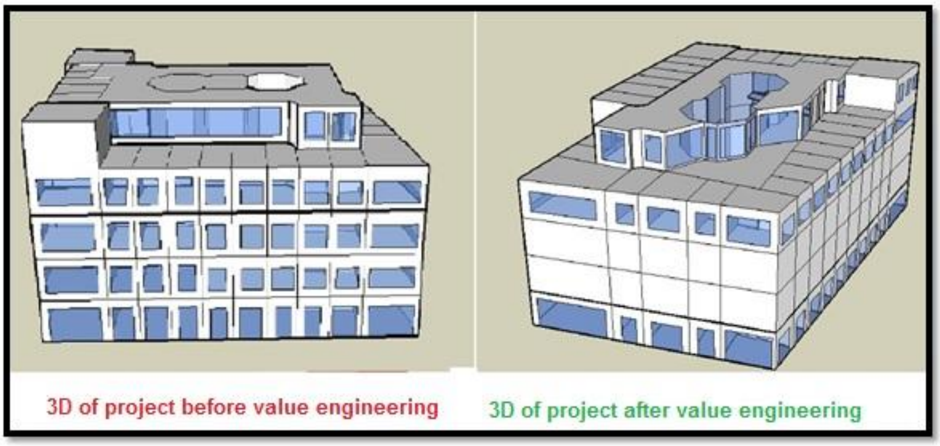


Figure 4.11. 3D modeling of project

	U.M	Current design	New design
The amount of energy consumed	MWh	2100	650
heating	%	53.50%	9.20%
cooling	%	14.50%	22.10%
lighting	%	12.10%	27.80%
electrical equipment and devices	%	19.90%	41.00%
The amount of energy consumed annually	sp	4,200,000	1,301,300
The amount of energy consumed annually	euro	64,615.38	20,020.00
Saving percent	%	69%	

Table 4.23. Consumption of the energy of project

4.2.6. Dezvoltarstion phase

		Project before applying value engineering		Project after applying value engineering	
Initial cost (design and execution)	Name of work	Total price (s.p)	Total price (€)	Total price (s.p)	Total price (€)
	Construction works	23,669,950	364,153	20,240,018	311,385
	Architectural works and finishes	30,099,724	463,073	32,361,204	497,865
	Electrical works	9,552,535	146,962	9,663,235	148,665
	Mecanical works	13,488,580	207,517	9,746,100	149,940
	Total	76,810,789	1,181,704	72,010,557	1,107,855
	Saving percent	6.25%			
Cost of operation	The amount of energy consumed annually	4,200,000	64,615	1,301,300	20,020
	The amount of energy consumed during the life cycle of the project (30 years)	47,282,690	727,426	14,649,753	225,381
	Saving percent	69.02%			
	Total	124,093,479	1,909,130	86,660,310	1,333,236
	Total saving percent	30.17%			
Revenues	Annual Project Income	55,657,704	856,272	57,006,660	877,026
	Project revenue during the life cycle of the project (30 years)	643,305,749	9,897,012	658,897,322	10,136,882
	Percentage of growth	2.42%			

Table 4.24. Final result of value engineering analysis

No.	Criteria	mark
1	motion through the project	7
2	the form of interfaces	8
3	the location of the project	7
4	safety	5
5	energy consumption	9
6	spaces	9
7	the initial cost	4
8	function of the program	9
9	future extension	5
10	neighborhood	6
11	duration of execution	7
12	operating costs	8
13	parking	5
14	environmental impact	7
15	construction method	5
16	area development	10
17	the light	9
18	ventilation	8

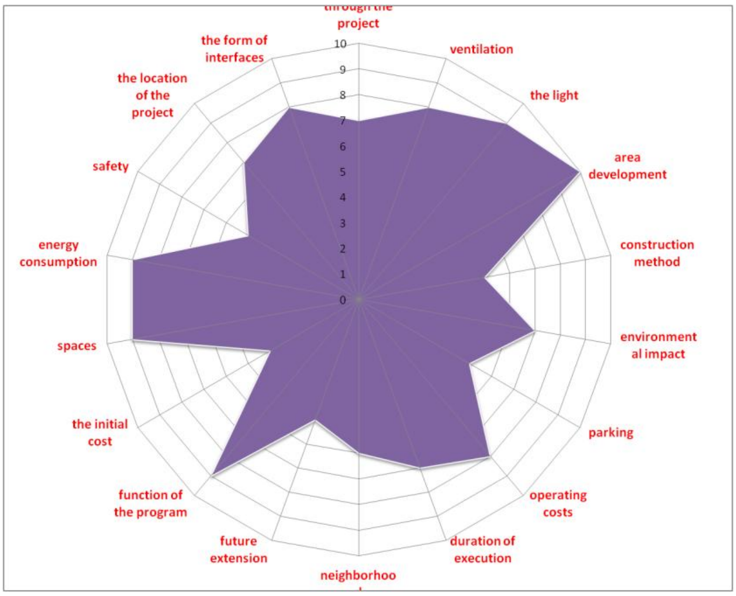


Table 4.25. Quality flower after value engineering

CHAPTER 5: Conclusions and Recommendations

In other words, it can be said that the value analysis is a method to improve the value of the project by improving the relationship between the technical and social functions of a project and its cost.

Value analysis (in the broadest sense) is a process that is geared toward performing the necessary functions for a project, process, or service, at a minimal cost, without affecting its quality, reliability, performance, and delivery conditions.

The term value analysis implies the application of these techniques to existing products. Value engineering is the application of "revaluation" techniques in the main stages of design, design and development.

In short, we can say that value analysis is a way of improving the technical, economical and aesthetic features of existing assets, and value engineering is a method of preventing and eliminating unnecessary cost-generating causes, even at project design level.[22]

The case study shows the importance of applying the methodology of value engineering, and how much giving benefits and profits to the investor and the owner.

The value engineering method is the scientific method that has been studied using effectively many global and local engineering companies and institutions. And its success is owed more easily to the decision-maker and at the same time helps him to achieve goals and activities with access to his desired functions, such as beauty, environment, safety, flexibility and other important factors that respect or exceed the expectations of the owner and the beneficiary.

The advantages of value engineering studies, as well as their correct application, include:

- Presenting ideas, analyzing alternatives and putting them into practice by a team of professionals.
- Determining the most appropriate method of execution and operation, maintenance with the lowest possible cost.
- Helps to reduce execution, operation and maintenance costs.
- Maintains the objectives and purpose of the project, such as quality and age.
- Avoiding the fragmentation of the project or its part, including a negative impact on the purpose for which it is created and for quality.
- Ensures optimal investment of state resources.
- Streamlining spending on government projects.

Value Engineering chooses alternatives and project activities in accordance with the environment and, according to the conditions that it preserves energy in the building during the investment period, as it focuses on project cost, life cycle cost, not just on initial cost. Even if the initial cost is high, it will work to save energy, positively reflecting the environment.

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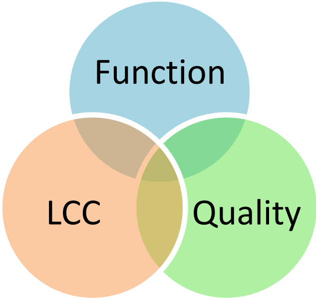

Figure 5.1. The concept of value engineering

There are many problems that go to unnecessary and high costs such as:

- Extensive design details are repeated from one site to another.
- Materials that do not have any user function (either use or aesthetics) are often used.
- New functional materials are not used.
- Classical methods are followed.
- Old methods go into design, contracting, and construction.
- Most construction jobs involve the three companies: Architects and engineers, contractors, and owners [23]

We need value engineering in our time for:

- control the increasing demand for natural resources;
- saving the resources;
- control the costs;
- Elevating unnecessary costs;
- Determine actual costs rather than initial costs.

Economic researcher Dr. Mahmoud Abdel-Fadil: "The decline in the investment rate in a large number of growing countries because of the social structure that allows for a large part of the economic surplus to the community for developing purposes not related through lost cost and phenotypic expenses. "

There must be specific criteria or manual version of the premises and the specifications for each type of buildings (buildings, educational specifications, tourism and services).

The development of industrial construction is done by developing value engineering programs by contracting with consultants and specialists. The value engineering approach is the most recent of other programs currently being applied in many areas of the country, focusing on:

- The spread of culture to value engineering on a wide range of courses.
- Creating specialized consulting firms and offices in the field of value engineering.
- Introducing the concept of value engineering into government contracts.
- provide the necessary books and references.

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❖ List of tables

❖ List of figures

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