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**DEVELOPING A MODEL FOR IMPLEMENTATION OF VALUE ENGINEERING SYSTEM FOR THE CONSTRUCTION PROJECTS OF EXECUTING CONSTRUCTION PROJECT-BASED COMPANIES (FOURTH FACTOR) CASE STUDY: CONSTRUCTION PROJECTS OF SOCIAL SECURITY ORGANIZATION**

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**ABSTRACT**

Value engineering system includes proposed and successful techniques in budget allocation, and cost-saving aspects regarding projects costs while maintaining the desired quality and utility during the lifetime of the projects with the age of 66 years in the world. Using value engineering system, we can create major changes in order to reduce the costs and time with maintaining the desired quality in construction projects of country .And considering the recent sanctions we can observe its impacts on national savings clearly. Considering that, Social Security Organization for the implementation of Housing and Hospital Projects is faced with problems such as excessive costs and this imposes a significant loss to the organization, in this research we have attempted to act for explaining term of Value Engineering in various phases of construction projects and provide a model for the implementation of Value Engineering in the fourth factor of Social Security Organization. Among the main recommendations for the implementation of Value Engineering system in this organization, we can mention the change of the type of contract between the fourth factor and Social Security Organization in line with Value Engineering, and aligning the economic interests of the fourth factor, consultants and contractor, for engineering value operations and avoiding short-term managerial changes.

**Keywords:** *Value Engineering, Social Security Organization, Construction Projects, Performance Improvement*

**INTRODUCTION**

Value engineering is a systematic attempt to analyze the performance of projects, systems, equipment, services and institutions in order to achieve real performance with the lowest cost over the life of the project which is consistent with the desired quality and safety. In recent decades, industrialized and developing countries and even the neighboring countries of Iran, have realized the necessitates of using effective methods and techniques for cost savings and have been seriously looking to reduce unnecessary costs (Frhmndazad, 2011). In our country and in the last few years, the Management and Planning Organization as the main responsible for solving the above problems has attempted to promote new approaches to management, and offer suitable strategies in technical and executive system of construction projects. Moreover, cases such as developing some rules, holding seminars, and publishing books in the above aspects can be considered in this line. Accordingly, wide spread attempts have been done for raising Value Engineering method in construction projects of the country. It is not worthy that the mentioned method has been able to cause large savings and revolutions in the developed countries.

Implementation of value engineering and its comprehensibility in terms of using knowledge, and other proposed solutions on the one hand, and the needs and requirements of the country for reviewing proposals to simplify and improve them and lower their cost on the other hand, have motivated many experts familiar with the concepts of value engineering to support the implementation of such methods, and each one facilitate fields necessary to implement them. This research is an attempt in this direction and deals with the application of value engineering system in construction projects of Social Security Organization.

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Value engineering is a management solution and a creative approach that uses functional systems approach objectives to find the best balance between cost, validity, and reliability of products or projects (Zaymrmn, 1982). In the other definition, value engineering is among the proposed and succeeded techniques in budget optimal allocation and the project cost savings over the life of the project. Value engineering is a very efficient technique to reduce the costs and time of projects with maintaining the desired quality and utility. Using value engineering techniques, it is possible to simplify and improve the quality and make affordable the costs of construction project. Value engineering can be viewed as a process of decision-making that considers the following items:

A: a systematic process of "optimizing operating costs."

B: an innovative approach to "Creation of Options" toward the implementation of plans and projects.

C: Orientation towards the satisfactory "performance"

D: Considering "cost" in the "current costs."

Value engineering aims at achieving the minimum costs without any reduction in quality, satisfaction, reliability and quality improvement (Jafari, 2000; Monden, 1995).

The central core of this system considers the "Targeted Costing" in order to "cut costs at the design stage" and long-term planning of profits as the target of value engineering. Cooper referring to the marginal utility (Cooper, 1997) believes that the "competition model program for reducing administrative costs, increasing marginal utility of services and facilities, increasing profitability in the competitive market and reducing costs, in line with the objectives of quality improvement are included as the objectives of Value Engineering.

Palmer, 2002, considers the optimization of needs and project-oriented products in order to create maximum customer satisfaction by utilizing partial method obtained through the results caused by utilization of value engineering. Enjoying the creativity in improving the quality, reducing unnecessary expenses, favorable function and optimization of activities can be considered as objectives of this approach (Sami, 2005). About benefits of value engineering factors, items such as risk aversion, improvement of quality, improvement and development of the project, increasing productivity and confidence, transmission of data, utilization of creativity in the affairs, reducing complexity of products and projects, minimizing waste of resources, reducing implementation of costs and improving operational and administrative aspects can be mentioned that provide financial cost optimization and improvement of municipal projects in city development and urban development of cities and increase the quality, reliability and keywords of Value Engineering and Executive credibility of the Projects. The following words have fundamental concept in value engineering and knowing them allows a better grip of this concept:

**1-Function:** The role that assists the targeted product in achieving the set goals (Monden, 1995).

A concept through which, value engineering describes necessity for raising the issue to avoid the innovated option to be based on a specific pattern.

**2. Performance:** Surface, performance objectives, it came into force.(Ibid.)

**3. Specifications and Features:** Features including special shape, dimensions, constituent elements, capabilities, performance, manufacturing test methods for materials and products (Ibid)

**4. Value:** Value has indicators that make possible the access to the maximum value.

Visibility of Value also becomes possible in response to three questions (Taghizadeh, 2001)

Value Engineering and Architectural Engineering in building design process

Value engineering design phase of the building and the commitment of implementing

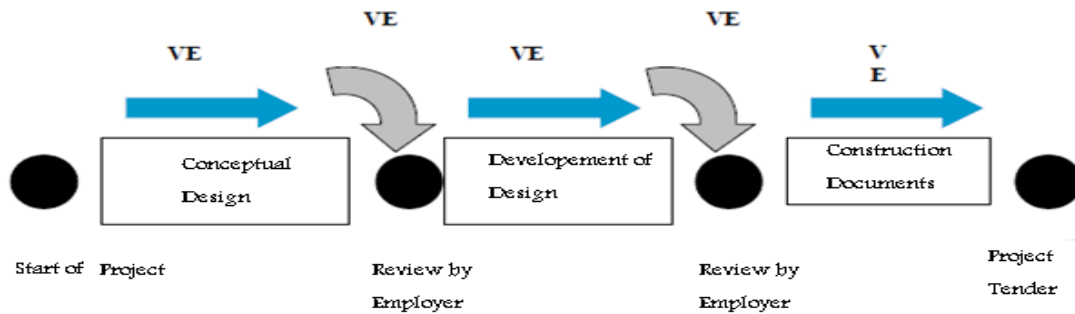
Stage of design needs high capability in value studies because while this stage encompasses about 1% of the total life cycle costs of building project but impacts over 70% of the cost of building life-cycle. Recognizing this stage is important because with having enough knowledge over the design process and enjoying a closer look at the way architects act when designing buildings, the shortcomings of values corresponding to this stage will be clarified through increasing their accuracy as well as the turning points that have the potential to realize the added value using them. Value engineering methodology in the design and implementation of housing projects is shown in Table1. The time for applying value

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engineering practices is shown in the design process of the new approach in the design and construction of housing projects in Figure 1.

**Table 1: Value engineering methodology in design and implementation of construction projects**

Preliminary Study
Collecting data regarding the desires of employers, consumers, purchasers
Completion of Datasets
Determination of appraisal of criteria
Determination of study range
Making data model
Determination of research team members
Studies of Value
Phase of Collecting Data
Phase of function Analysis
Phase of Creativity
Phase of Assessment
Phase of Development
Phase of Presentation
Supplementary Studies
Completion of Changes
Implementation of Changes
Audition

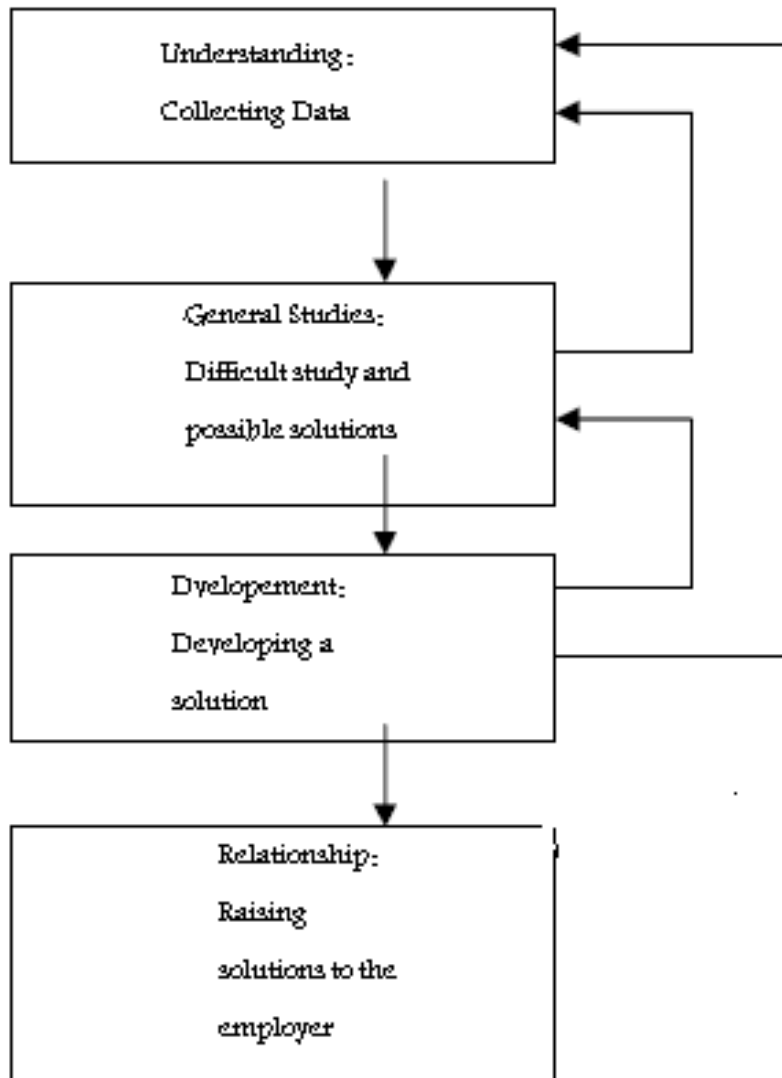


**Figure 1: The time of applying Value engineering throughout the design (new approach)**

**Value Engineering Methodology in the Design Process:**

Recognizing components of the design phase in a systematic approach, i.e. the schematic design, design development, construction documents and details of the activities performed in each of them, perception and understanding of value engineering affairs will be materialized in the end of each of the sub-steps in terms of step by step and gradual formation of intended facilities and demonstration of some design features in each sub-step. The importance of design phase in the value engineering approach is greatly felt because among four phases: feasibility of projects, design, construction and operation are the most important stages of construction projects on the scale of design phase value that with consumption of only one percent of the costs related to the construction projects, the total costs of project life will be impacted at the rate of seventy percent. In a systematic approach, the design phase is considered as a system that contains inputs of stage design, design order, feasibility studies and architectural conceptions and their output consist of drawings and construction documents related to the project. In Figure 2, the housing design process while the application of value engineering is shown.

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**Figure 2: Design Process Methodology**

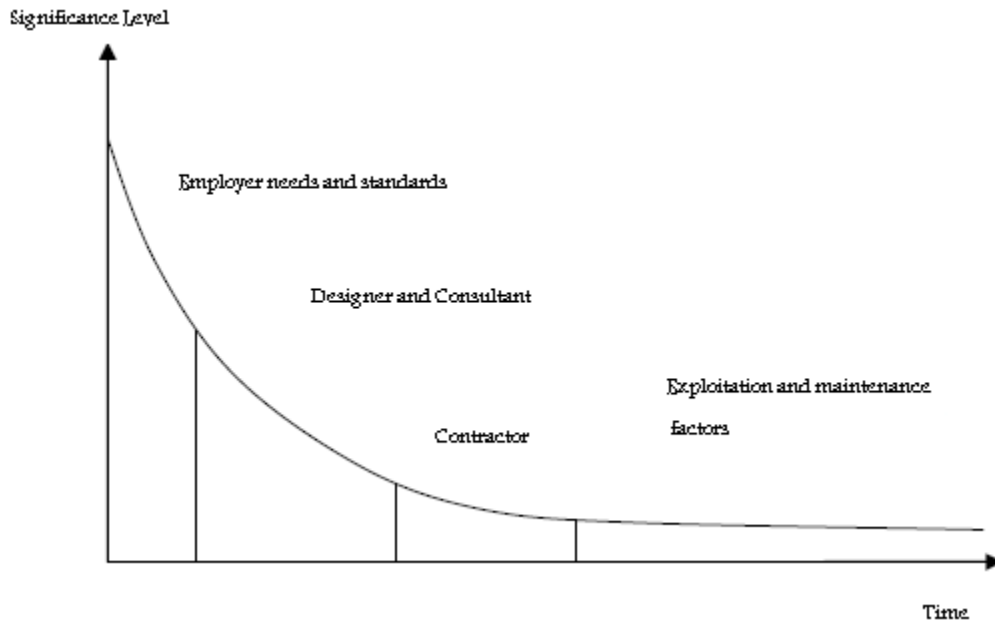
Design phase is divided into three sub-steps and normally at the end stages of conceptual design and design development, a revision will be made by the employer to ensure compliances of design with the expectations of the employer.

In the methodology of designing, theoretical models exist for the explanation of design as a systematic and logical process. However, the architectural design process encompasses various approaches and for example the Architectural Management Handbook explains the design process in the following four steps:

1. Perception Understanding and data gathering.
2. General study of identifying the problem and exploring possible solutions.
3. The development and generalization and development of optimal solution.
- 4- Exchanging solutions with employer.

Considering the design phase as a system, the reasons for the minimalist of value will be discussed in three parts of system input, output and central processing and hardware and software of the system .The reasons for the occurrence of minimum value (Zaymmn, 1995) can be sought in cases such as lack of time, lack of information, lack of ideas, false perceptions, manners and customs, norms, value, policy, lack of financial resources and temporal events that are permanent.

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**Figure 3: The project factors effect**

Looking at Figures 2 and 3 it is clear that, a new approach is considered in application of value engineering that have changes in the conceptual design stages of design development and construction documents that will be referred in the following.

**Schematic Design or Conceptual Design:**

In this stage, the general forms of the facilities will take shape and if these general form to be approved by the employer at the end of the process, the project will enter design development phase for examination of details. The outputs of conceptual design stage in each of the sections of 1- Architectural design 2- Structural design 3. Mechanical Design 4- Electrical Design 5- Landscape design 6-The interior design are as follows:

**Table 2- The outputs of the conceptual design phase**

<b>Interior Design</b>	<b>Landscape Design</b>	<b>Electrical Design</b>	<b>Mechanical Design</b>	<b>Structural Design</b>	<b>Architectural Design</b>
Internal partitioning perspective	Design criteria	Initial plans for ceiling lighting	Design Criteria	Design Criteria	The initial plan for the site
Initial plans for furniture	The primary plan of green space	Power lines and keys	Consumption and maintenance of energy	The primary structural system	The initial plan for floors
Primary Tables of joinery	Piping works related to landscaping	Communications equipment	Standard and type of primary HVAC system	Options for structural systems...	The initial plan for Roof
	Electrical works	Protection against	Types of Pipes	Plans and sections	Primary sections
	<b>Associated with the area</b>	<b>Fire</b>	<b>Recharge and discharge</b>	<b>and Schematic of Frames</b>	<b>of</b>
	Alternative	Security systems	Protection	Plans	and The initial

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concepts of landscape	of	against fire	schematic sections of frames	external heights
	The size of the main electrical equipment	Estimating the space mechanical equipment in the plan	the for Schematic foundation plan	The initial internal heights
	Alternative systems	Estimating the required space for mechanical equipment	the space structural sections surface	The initial sections of pipes
	Energy conversion and storage rooms	Alternative mechanical systems	Initial Calculations	

**Design Development Phas**

At this stage, the design will be discussed in detail and the design estimates about the dimensions, sizes and volumes of the previous stage will be converted to the specified numerical values.

The outputs of conceptual design stage in each of the sections of: 1- Architectural design 2- Structural design 3. Mechanical Design 4- Electrical Design 5- Landscape design 6-The interior design are as follows:

**Table 3: Output of design development phase**

Interior Design	Landscape Design	Electrical Design	Mechanical Design	Structural Design	Architectural Design
Landscape of internal partitioning	Landscape Plan	Ceiling lighting plan	Control of vibration and noises	Design and Criteria	Plan of Site
Furniture Plan	Piping affairs associated with site	Power lines and keys	Type and standard of HAVC system	Structural Network	Plan of Floors
Tables joinery		Fire detection and alarm systems	System of protection against fire	Sections of Structural Frames	Sections
		Security Systems	Standards of charge/discharge pipes	The initial plan of foundation	Exterior Heights
		Communication Systems	Equipment placement location	The approximate dimensions of structural members	Sections of Walls
		Duct dimensions and location	The size and placement of ducts	Calculations	Interior Heights
		Rooms for conversion and storage of electrical energy	Calculations (HAVC)	Building materials tables	
			Equipment and Materials Tables		

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**Construction Documents**

At this stage of design, the last changes and modifications required reaching definitive specifications for the preparation of construction documents and drawings will be applied. The outputs of conceptual design stage in each of the sections of 1- Architectural design 2- Structural design 3. Mechanical Design 4- Electrical Design 5- Landscape design 6-The interior design are as follows:

**Table 4: The outputs of construction documents phase**

<b>Interior Design</b>	<b>Landscape Design</b>	<b>Electrical Design</b>	<b>Mechanical Design</b>	<b>Structural Design</b>	<b>Architectural Design</b>
Landscape of internal partitioning	Landscape Plan	Ceiling lighting plan	Control of vibration noises	Design and Criteria	Plan of Site
Furniture Plan	Piping affairs associated with site	Power lines and keys	Type and standard of HAVC system	Structural Network	Plan of Floors
Tables joinery		Fire detection and alarm systems	System of protection against fire	Sections of Structural Frames	Sections
		Security Systems	Standards of charge/discharge pipes	The initial plan of foundation	<b>Exterior Heights</b>
		Communication Systems	Equipment placement location	The approximate dimensions of structural members	Sections of Walls
		Duct dimensions and location	The size and placement of ducts	Calculations	Interior Heights
		Rooms for conversion and storage of electrical energy	Calculations (HAVC)	Building materials tables	
			Equipment and Materials Tables		

**The Input of the System**

In addition to design orders and feasibility studies, the architect attempts to collect information for understanding and explaining the problem, also he observes the tools for this understanding and inform the employer in this regard, and he interviews with employers and stakeholders of the project. Moreover he forms minimalist of value in the input section of the incorrect communications that contains the misinterpretations and misunderstandings which is considered the foremost factor of minimalist. The reasons for this incorrect communication should be sought in the educational background of education level and training but misinterpretations are inevitable in any case.

**The Hardware part of the System**

The architect's mind is considered as the central processor that is intended to get input and clarify it in the issue deals with explaining the design response. Value deficiencies of the hardware section can be for this

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reason that the mind of the architect such as the minds of all human beings has weaknesses and disadvantages that will be briefly mentioned in the following parts:

*Lack of Information*

Lack of information, arises because of lack of access to accurate facts and details relating to costs, and product characteristics as well as misunderstanding and providing incorrect definition of needs and the problem. Lack of information on advances in technology through which the development of processes, products and materials often make possible the performance of functions with less cost and more effective ways is among other things that include the misperception of the design process.

*Lack of Creative Ideas*

The lack of new and creative ideas arise due to lack of use and adequate application about existing information, technical knowledge and the specialized skills of the company standards and creative thinking time opportunities.

*Incorrect Common Beliefs*

Incorrect common beliefs may occur due to lack of ideas and accepting the beliefs, rumors, heard cases, the speculations and theories without any justification and reasoning

*Habits, Attitudes and Mental Obstruction*

Human is a creature that obeys habits easily and experiences, beliefs and traditions of the past develop certain patterns in his/her behavior and thinking manner in a familiar way.

So that they make him/her solve similar problems in a similar manner and resist change for achieving new solutions.

*Risk Aversion*

Any architect or urban planner engineer and urban development expert knows that there is no inevitable issue. And with all these circumstances it is deemed that what has repeated many times in the past is less likely to face failure compared to what is new or unknown.

*Designing and Estimating more than what is required*

Typically, designers, rather than a detailed analysis designed implement the design by enhancing the safety factors.

The value engineering and implementation of housing projects

This building has 8 floors and its total area is about 8043.24 square meters. The total estimated cost of the project was 95 Lech. The structure of the building was created by reinforced concrete and the columns were located on successive discrete foundation at distance of 6 m c/c. The original approach was based on the implemented plan of the building, and accordingly, the existing construction system which was a one-sided 12 x 12 meter panel with reinforced concrete panel evaluated at establishing the roof using one of the following options:

**Table 5: Cost of Project (USD)**

Total Cost	Executive Expenditures	Building Materials	Option
108,600	12,100	81,500	Available Plan
34,784	11,870	23,114	Corrugated sheet
48,118	16,081	27,027	Membrane roof
42,557	10,870	31,887	Bilateral roof slab
30425			Metal roof system

After the initial assessment and developing evaluation matrix, the corrugated sheet was considered as the proposed system that yielded a savings as much as 68,816 \$.



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Value engineering and implementation of it within construction projects of Social Security Organization  
The Social Security Organization produces significant projects each year through Design and Implementation of Housing Company of Iran.



**Figure 4: Organizational position of project executer toward Social Security Organization.**

According to what mentioned above, the proposed model for the implementation of Value Engineering system in the Social Security Organization projects are as follows:

- A- Creating organizational culture of Value Engineering in technical office of the Social Security Organization
- (B) Changing the type of mutual contract between the fourth factor and the organization, for implementation of value engineering
- C. Approval of the project Value Engineering exercises on the projects in the executing construction projects of the company
- (D) Establishing organizational culture, detailed training of Value Engineering, creation of motivational factors
- (E) Applying value engineering rules within the design consultants contracts
- (F) Contracting with skilled independent consultant of value engineering for reviewing the plans
- G. Using VECP in the current contracts
- H- Creating value engineering in technical and planning assistance under the fourth factor
- I- implementation of value engineering as well as monitoring and reporting it to the employer organization, through the project management unit

### RESULTS AND DISCUSSION

Increasing expansion of the value engineering architectural projects in the world can prove the high potential of this approach to cost reduction and quality improvement of the projects in particular housing projects so that more than 60% of the housing projects are accounted for the application of value engineering. In the meantime, considering the trend of value engineering in the Housing Design Process and after that, construction phase is important.

So that the design phase includes three phases: conceptual designs, design development and construction documents. The more we go ahead from the conceptual design to construction documents, the costs of applying changes and costs reduction potential will reduce and thus the potential of net savings reduces continuously. Thus, value engineering, in the early stages of the design, or the production of design options, in the conceptual design stage and before entrance of design into detailed stages will create more value saving.

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Social Security Organization produces new projects by Iran House Building Company. Implementation of value engineering projects in the construction projects of this large organization can cause considerable savings.

Considerable point are subtle hints that with regard to the the position of the executive company of the project (fourth factor) should be considered in this implementation.

**Table 5: The process of implementation of Value engineering system in the project-based organizations of the Fourth Factor**

Fourth Factor (House building company of Iran)	Employer (Social Security Organization)	Country
Creating the organizational culture of Value Engineering as well as holding training classes regarding Value Engineering and introducing the benefits of this technique and providing physical and spiritual motivational factors for the participants in the courses and the main process of Value Engineering	Establishing the culture of Value Engineering in Employer Organization interacting with the Fourth Factor ( Engineering & Technology Office of Social Security Organization) through holding classes and courses of familiarity with Value Engineering	Creating a comprehensive system for policy-making and directing Value Engineering in construction projects
Applying the subject of Value Engineering within the contracts of the consultants regarding the outsourced projects (and those will be outsourced in the future)	Examining and changing the type of contract (if required) between the	Passing specified and binding laws regarding the Value Engineering
Signing contract with the skilled independent consultants of engineering affairs regarding the projects will be designed by the Fourth Factor as well as inclusion of requirements of Value Engineering knowledge transfer TO THE Fourth Factor in a specified period	Fourth Factor and employer for compliance the mutual contract with application of Value Engineering process	
Inclusion of Clause VECP into contractors' contracts		
Creating the Value Engineering unit interacting with the independent consultant of Value Engineering and the consultants of the outsourced contracts and the contractors, in the section of designing the Fourth Factor		
Beginning the engineering process and holding the workshops and following-up the application of results in the projects through the project control unit and reporting to the employer's organizations		

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