

## Value Engineering Approach in the Underpass Projects in Iran: A Case Study in Gachsaran Underpass Project

Behnam Khademi<sup>1\*</sup>, Masoud Beheshti<sup>2</sup>

<sup>1</sup>Construction and Project Management, Sirjan Science and Research Branch, Islamic Azad University, Sirjan, Iran; <sup>2</sup>Department of Natural Resources, Sirjan Science and Research Branch, Islamic Azad University, Sirjan, Iran

\*E-mail: Behnamkhademi38@yahoo.com

### Abstract

Every year country is suffered from a huge amount of damage which is caused by unfinished construction projects. Most of these losses are resulted from the lack of allocation of funds timely as well as the disproportionate costs to the functions of the project. Considering that, Iran is a developing country and due to this development-oriented approach, every year many schemes and projects are implemented. If a technique is to be applied to minimize the large construction projects cost, it can contribute to finish projects rapidly and exploit them quickly. The change proposal by value engineering method is a management technique of cost reduction which is able to increase the qualitative criteria of the project. In this method, contractors propose their creative ideas for improving the running project by applying value engineering pattern and after confirmation and the exact audit, a percentage of savings is awarded to them to encourage and compensate the loss resulted from costs reduction of the project. This study aims to increase the application of change proposal methodology in the civil projects of country and utilize its benefits. Initially, this study tries to introduce this methodology by investigating the fundamental concepts of this method and pointing to the advantages of this managerial technique compared to other methods as well as examining a successful external and internal study and finally, by conducting a value engineering study on it begin to propose a suggestion to extend the application of this managerial technique in the civil projects of country. According to the results of this study, the capabilities of this managerial new method can be utilized optimally to improve the civil projects of country by paving the ground and disseminating the culture of utilization of change proposal in the projects and reforming relevant laws and rules and also removing administrative problems and facilitating the implementation trend of change proposal.

**Keywords:** value engineering, variation suggestion by value engineering methods, cost reduction.

### Introduction

By beginning the developmental programs of the country, the huge investments were made in infrastructure sectors and are currently ongoing. During the design and implementation of these projects, it is observed that in most projects the initial anticipated cost and time has increased significantly and in some cases, the implemented projects due to the lack of observance of study of all aspects are not justified economically. A brief review of the monitoring report which is prepared in 2007 by the Office of Monitoring and Evaluation of Plans in Strategic Management and Supervisory Organization of President (former Management and Planning Organization) verifies the above mentioned issues. During the monitoring visit of the 613 completed project, the mean construction period for these projects 10.7 years, and the mean latency period of their operation until the report preparation have been reported eight years (the monitoring visit report of national civil projects in 2007). Value Engineering is an organized group effort, with the participation of all agents

who know subject for functions and costs analysis to improve the value and performance of the project and plan of new methods or the removal of non-essential costs in order to reduce total costs, performance improvement and quality enhancement. Value engineering is a dynamic process in which all stages of the project are fruitful. One of the most important phases of the project is the construction phase and the main part of the project costs is spent in the construction phase. Therefore, this phase can be very suitable context for conducting value engineering studies. The value engineering technique in the construction phase can reduce the costs, runtime and increase the coefficient of operations importance (quality, ease, speed and performance safety). The changes that value engineering can do during the implementation are divided into two categories. The first set of changes is conducted by the consultant in the construction phase when the implementation problems occurs and the second set of changes refers to the contractor's proposed changes which is based on the variation of a part of designing or the utilization of new materials and new implementation methods and its implementation is subject to the approval of project advisor or employer.

Value Engineering Changes emphasize on the change proposals proposed by the contractor and also investigate the potential of this management method in the construction projects improvement by examining the status of civil projects of country briefly, investigating the problems and the main causes of their delays and also by reviewing the experiences and achievements of leading countries in the field of value engineering in construction period and through comparison of Iranian change proposal guidelines with leading countries' guidelines and imitating their strengths, try to remove the implementation barriers and facilitate the presentation, investigation and evaluation process of the contractors' change proposals. Finally, this study by conducting the value study on the change proposal by value engineering method and evaluating the creative ideas of value engineering graduates of country, try to offer suggestions for improving the rules and existing guidelines in this regard.

### **Statement of Problem**

The value engineering methodology is the new management technique that in addition to being introduced as a necessity in many organizations and governmental agencies, has opened its own position in the field of law that has been appeared with the names of value engineering, value analysis, value management, etc. and with the general similarity to the principles, concepts and difference in the scope of work. There is a large time interval from the innovation of this methodology in 1947 so far which provides the possibility of using experiences of leading countries in this field. Value engineering guidelines in the planning and management organization construction period have been examples of these cases which are closely picked from several foreign regulations.

The change proposal by value engineering method is a proposal that is provided by contractor during the contract in order to reduce implementation costs, operation and maintenance, performance promotion or other benefits of employer and at the same time, doing things must be done with better quality or according to the contract. In the change proposal by value engineering method contractors propose their creative ideas by applying value engineering pattern for improving the running project and after verifying and the exact audit, a percentage of savings is granted to them as reward. Obviously, this engineering win - win attitude, in addition to accelerating the implementation of the plan and improving its quality grants great interest to the employer and the contractor. The change proposal process by value engineering method in other countries has a great history, but a few years more will not pass from its practical entry into the country and its implementation in the Iranian projects. At this time, partly legal conditions are provided for its implementation in the various projects of country and some organizations have applied them in

improving and reforming their different projects. However, the number of application and the amount of saving achieved in such projects is negligible compared to its application potential. Little experience of change proposal by value engineering method in Iran reflects this fact that still appropriate and acceptable results have not been obtained from the application of value engineering. This study attempts to identify the main factors limiting the application of this method and presents suggestions for solving problems and facilitating the implementation process of this methodology.

### **The significance of study**

Managerial practices have been ignored in our country due to the excessive attention to the administrative and technical issues. Iran, unlike the leading countries is far from the advantages of management methods in the field of management. The neglect of the advantages of this method is due to the lack of the familiarization of this methodology to the engineering community of country and the lack of deep researches in this field. Value engineering and also change proposal by value engineering method is one of the powerful management tools that has left the financial savings, quality improvement and a lot of efficiency in projects of other countries, but unfortunately, this methodology has been incapacitated in Iran.

### **Objectives of the study**

The main purpose of this study is to evaluate the Change Proposal methodology by using Value Engineering method (VECP) and also investigate its implementation possibility in civil projects of the country. Identifying problems facing the change proposal in civil projects, investigating the conducted actions at the international level regarding the application of the change proposal and its general results, examining the existing potentials in unfinished and problematic projects of country by using the value methodology and change proposal and finally, reform proposals of preparation, presentation and investigation instruction of change proposals with a value engineering view to promote the application of change proposals in civil projects of country are other objectives of this study.

### **Data Collection Methods**

In this study the primary information is gathered through library researches, reviewing the reports of related organizations, investigating the researches that are relevant to the study, also the study of scientific articles, report of executive agencies and the seminars held in the country and other leading countries in this field and then by using field survey (questionnaire) the data related to the value engineering study is collected and with the formation of value engineering team the study of value on change proposal by value engineering method has been done.

Studies conducted in 1969 by American air facilities began the value engines' education program. In 1977, the Indian Value Engineering Society was established in October of the same year and the first National Conference held in Delhi.

In 1980 the Japanese government to implement its projects in Jamyshapvr city of India applied the value engineering in its own projects.

In 1990, the state of Virginia in America was the first State of the United States that compelled the application of value engineering on the design and construction of more than two million dollars highways and projects.

As it can be observed from table 1, the visited projects that have started before the Third Development Program (858 Project) had 35.8% credit weight that were lasted by the end of 2007 namely about 16 years and the mean weight of the physical progress of this group of projects is about 60.7 percent. The viewed projects that have started during the Third Development Program

(1156 Project) with 39.1% credit weight which were lasted by the end of 2007 averagely about 6.3 years and the mean weight of the physical progress of this group of projects is about 47.4 %. The weight mean of implementation length of 613 monitored projects that have been exploited in 2007 is about 10.7 years while, the time taken for the new projects completion in 2007 is averagely 2.6 years and the weight mean of the predicted time for entire projects completion is 9.9 years. Disproportion of existing facilities and the volume of ongoing civil operations create about 8 years interruption in projects scheduling and consequently the utilization of funds in the form of unfinished projects which is stagnant decreases. Among the major causes of project delay can be pointed to the lack of credit allocation (30.2 %), lack of approved credit (22.5%) and weakness of some executive agencies (11.8%). Other important causes of project delay refer to the problem of preparing the ground (5.5%) and the inability of some contractors in project implementation (5.5 %).

**Table 1. Physical progress status of civil projects based on the year of onset**

Implementation weight mean (year)	Physical improvement (%)	Financial weight (%)	%	Number of projects	Date of starting the project
16	60.7	35.8	24.4	858	Before Third Development Program
6.3	47.4	39.1	32.9	1156	Within Third Development Program
3	387	10.7	16	563	2005
2	18.1	8.5	9.8	343	2006
1	21.5	5.9	16.9	593	2007
8.7	47.1	100	100	3513	Total

#### ***Technical specifications of urban underpass of GACHSARAN***

The subject of project refers to the implementation of structural underpass and the central part of its stations located in the path of GACHSARAN urban underpasses which is from +749.70 to 3+762.99 km. Stations are respectively located in +800, 2+200, 3+600 km. According to the plan of Petroleum Engineers Company of the southern parts, the structure of underpass is in the form of reinforced concrete box section with internal dimensions of 5.7 × 8 meters which is located in depth of 8.5 to 10.5 meters from the surface of natural ground. The structure of underpass has formed of the Situ concrete floor and walls and prefabricated concrete roof with T-shaped beams that is installed on walls in modules of 1.25 meter and the station structure has comprised of floor, columns, reinforced concrete roof with bilateral columns that the length of these stations is 100-meters and with inner height of 7.20 meter and its free width between columns is 4.4 meters.

Introducing the project volumes

Earth Operations: 434,000 cubic meters

Formatting: 123, 700 sq.m.

Reinforcement: 3.300 tons

Concrete: 53.500 cubic meters

Prefabricated concrete beams: 9.600 cubic meters

Insulation: 98.600 sq.m

The advisor's estimated total amount for this piece is 76,555,539,000 rials and its implementation duration is considered 20 months. The Zeydon Koush Company by understanding

the importance of value engineering topics and the extent of its application has taken steps in this field and in order to optimize the project and save the national capital has conducted value studies on third piece of urban underpass project of Gachsaran in order to be pioneer in the field of conducting professional value engineering study among the existing contractors in the country.

***The implementation stages of underpass structure based on the contract***

The implementation of underpass structure based on the contract has been excavated and covered. In this case, the cross section of the tunnel is specified by the figure and excavated and after implementation of the desired structures it is covered.

***The implementation of the tunnel structure by primary method (contract) by using the prefabricated roof***

1. Implementing the core parts of the underpass and establishing the base points
2. Excavation, digging foundation and the channel of the underpass structure location by following the specified figures in the executive maps
3. The implementation of an insulating layer including HDPE sheets with a layer of protective geotextile or PVC sheet
4. The implementation of concrete floor
5. The implementation reinforcement and concrete placement of foundation
6. Insulating the behind of walls
7. Reinforcement, formatting and concrete placement of sides of walls and the preparation of living of prefabricated beams
8. The installation of the prefabricated roof beams
9. Completing the walls' connection and prefabricated beams by Situ concrete
10. Implementing an insulating layer including HDPE sheets with a layer of protective geotextile or PVC sheet and covering it with a layer of sand
11. Preparing the proper soil and filling the prefabricated beams
12. Restoring the amputated passages and streets to the initial state

***The implementation of stations by primary method (contract)***

Due to the presence of municipal utilities in the street and the impossibility of implementation of stations by excavating and covering method, it is essential to use another method to implement the stations and after conducted investigations the executive operations of stations were done by the top-down approach. These operations include the following steps:

- Drilling the location of columns
- The construction of the prefabricated columns in the workshop and installing them in their own place
- Insulating the roof, embankment and restoring to the initial state
- Under roof excavation of the stations
- Run the floor, gateways and platforms

***The purpose of value engineering study of Gachsaran urban underpasses***

The purpose of conducting value engineering study on this project is to reduce project cost, runtime and simultaneously, maintaining the quality and consumer needs and benefiting from the project. The above goals should be achieved in a ways that will meet the requirements of the plan consumer. These requirements include:

1. Transferring the passenger by using suburban bus system
2. Reducing the travel time to the urban areas
3. Decreasing or eliminating the urban crashes
4. Reducing the noise and environmental pollution
5. Increasing the travel speed of citizens

6. Transferring 7500 to 9000 passengers per hour in each direction
7. Improving the access status to the outside areas of the city

**Table 2. Some of the ideas derived from the idea making stage of tunnel sealing**

1	Removing geomembrane and the use of high quality concrete and water stop in executive crevices
2	Eliminating the geomembrane and the use of compacted soil behind the walls and on roof and water stop in executive crevices
8	The use of concrete sealing
9	The use of drainage around the structure instead of geomembrane

**Earthworks**

35	Proper planning on excavation during the embankment of other path
38	Proper formation and mixing of soil for embankment
39	Spread soils derived from the excavation around the newly harvested green space and near the project
52	Drilling in cross section of bridges
57	Decrease slope about 5%
59	The use of shield to eliminate the slope

**Station Structure**

68	The use of prestressed concrete
69	The use of self-compacting concrete
70	The use of spatial structures
73	The use of fiber reinforced concrete (FRC)
74	The use of high strength steel
89	Implementing the open station open and remove the roof
94	The use of masonry materials or prefabricated concrete parts for the back of station's columns

**Tunnel structure**

96	The use of masonry materials instead of concrete walls
97	The use of micro silica to improve the strength of concrete
98	The use of precast concrete for the walls and signifiers
106	The use of additional material in concrete
107	Removing the structural floor signifier
114	The use of prestressed beams
115	The use of arched signifier for the roof
118	Obtaining the approval of the relevant organizations and organs in underground establishment
119	The use of specific concrete

***Identifying the existing plan***

On the first day of the main study a brief tutorial was conducted by Mr. Donald and prominent value engineering expert team to familiarize team members with value engineering methodology and the process of study. Then, by presenting four main questions began to identify the existing plan. The proposed questions include:

- 1 - What is the existing plan?
- 1 - What should existing plan do? (Conceptual)
- 2 - Is the existing plan really necessary?

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### 3 - How much is the cost of existing plan?

When all members of the group reached consensus on the understanding the existing plan by presenting four key questions, the function phase was begun. Initially, in this phase the whole project was divided into five main sections, which include:

1. Sealing of underpass (geomembrane) 2. Earth operations 3. Bus stations' structures 4. Concrete structure 5. Miscellaneous. From the total project cost about 5,471,000,000 Rials are related to the geomembrane, 12,343,000,000 Rials spent on Earthworks, 7,978,000,000 Rials to stations structure, 38,041,000,000 Rials on concrete structure and 12,722,000,000 Rials are related to miscellaneous items.

#### *The evaluation of ideas*

After gathering ideas, all ideas were evaluated by using a survey of all members of the group. The criteria that were considered for evaluation of ideas included:

- 1 - Is this idea acceptable in terms of laws and standards or differs from them? (AC)
- 2 - Is this idea an operational and practical one? (PR)
- 3 - The application of this idea is hard or easy? (Does the application of this idea need large changes in the status quo?) (ID / E)
- 4 - The cost to use these ideas is high or low? (HC or LC)

After reviewing these criteria, according to the conducted investigations, the likelihood of accepting employer for them was determined and finally, the ideas were selected with equal or more than 70% probability of accepting employer and the rest were excluded. Evaluation matrix of a number of ideas is shown in Table 3.

**Table 3. Summary of Value Index - Solution Number 35 and 38**

Project Title: The third segment of urban underpasses
Describing the proposal item: Soil stabilization obtained from excavation with lime and uses them for embankment
The reason for considering this option: - It reduces the volume of soil transport. - It reduces the transportation cost relevant to the embankment.
Interest: - Cost reduction - Reducing the time
Approximate cost of the solution (value): Cost of the existing project: 5,137,170,400 Rials 7,143,529,100 Rials
Value Index (labor costs) / (function value) = VI The approximate amount of saving: $5,137,170,400 / 7,143,529,100 = 0.72$ 2,006,358,700 Rials
The acceptance probability: The probability of application: 95% to 95% Summary of proposal item: Modification of taken soil to embankment

The followings are the summary of solutions and savings resulting from the above estimations:

1. Savings resulting from solution 115 (b) is ruled out by utilization of solution 115 (a), and has not existed in this set.

2. From savings caused by solution 39 only the amount of 2,187 million Rials were calculated in this set because the rest of them are included by implementing solutions 35 and 38.

3. Solution 94 was not included in this set because it was not in the framework of the contractor's contract and has not been included in the existing project cost.

4. Solutions (97, 106 and 119) and 118 were not included in this set because spending cost increases the useful life of the project or accelerates its completion.

As can be seen in Table 3, according to the initial design of ideas and their approximate costing, the value engineering study has led to the creation of 19% savings in the project cost. While, in addition to the reduction of project cost, the reduction of runtime of project, the enhancement of its lifetime are considered as other achievements of this study.

#### *Meta-study stage*

After the presentation of achievements derived from the study, the mentioned description of the employer's plan, the result of investigations conducted by the employer, confirming 4 of 9 ideals was proposed as following:

1. Solution number 1: Eliminating geomembrane and the use of high quality concrete and water stop in executive crevices.

2. Solution number 35 and 38: Warehouse soils derived from the excavation, and modify them in order to use in the embankments

3. Solution number 57: Excavation slope reduction to about 5%

4. Solution number 11 (A): The utilization of arched -situ signifier in the roof

After confirming 4 above ideals, their final design was done and their precise cost was determined. The obtained results were recorded in forms that have been announced by the Management and Planning Organization of country. Finally, 21% of the project cost which was equal to 14, 600,000,000 Rials savings was achieved in project cost.

**Table 4. The form of Management and Planning Organization of country- Option 115 (a)**

Raw	Description	The total amount to Rails
A	The cost of first option implementation	35,645,876,098
B	The cost of the change proposal implementing	28,808,009,151
C	Saving in executive operations (a - b)	6,837,866,947
D	The gross savings (other saving, increasing the costs of exploitation period- savings of exploitation period - c): (costs and savings of exploitation period is applied if to be computable)	6,837,866,947
E	Costs of provision, preparation and design of the change proposal by the contractor:	180,000,000
F	Operational costs of employer (supervision and coordination, fees of consulting engineer and appraisal group, Modification of suggestion, experiments, evaluation and further investigation, etc.):	---
G	The total savings of contract (e and d):	6,657,866,947
H	The contractor's reward from savings (from 25% to 45% part (g):	2,996,040,126
I	Reducing the amount of contract (H - E - B - A):	3,661,826,821
J	Collecting the real savings of employer (f and - i):	3,661,826,821



## Results

1. Due to the buried nature of the structure by the use of curved roof, especially in the form of situ can achieve the significant savings in the project.

2. Due to the low groundwater level and soil type of the location, it was concluded that the geomembrane of floor and wall can be eliminated and by using high quality concrete implementation and water stop in the executive crevices can provide the required amount of sealing.

3. In order to prevent soil shipped from the excavation site to the far warehouse, some of it after stabilization with lime was used to embankment and the rest were spread around the green space of the project.

4. Slope of excavation was reformed in the form of staircase in the two phases in order to reduce the concrete consumption so that in the first phase, it was drilled from the surface to the wall's upper level with 10% slope and then by building a stair with a width of 70 cm, the second phase of excavation was implemented as vertical to the desired depth.

5. The quality and lifetime of structure can be significantly improved by using the existing advanced concrete technologies in the country and with low cost.

6. By forming a committee of experts and representatives of utility organizations and the presence of committee, the unpredicted sectional and multiple stops can be prevented during the implementation of the project.

7. By using simple pieces of precast concrete and putting them behind the columns of stations without connecting a structure to them, embankment can be done behind them and traffic can be returned to its original status as soon as.

### Specific procedures performed in the project

1. The problem of lower vertical trench excavated in value engineering design

The implementation of retaining piles and the inhibition of the excavation walls due to the continuous falling and adjoining to the five-floor apartments of Shahrake Qods and lack of soil consolidation around the Shahrake Qods and the existing fallings and considering that the distance of residential apartments to the excavation trenches is about 5 meters, the excavation walls stabilization plan in front of the buildings was carried out by the contractor.

2. Making low the available road's level in order to alleviate over the sewer pipes  
After performing foundation digging, it was observed that the soils on the sewer pipe was longitudinally at a distance about 2 meters from the tunnel's wall with manual type and low viscosity. The existence of this soil led to severe falling in the third part of adjacent pieces and contractor provided and implemented the plan of making low the available road's level to reduce the load on sewer pipes and prevent soil detachment and its buoyancy and to minimize the manual soil on the pipe and this prevented the possible collapse.

3. Changing the excavating and covering method to the top and down

In 250 meters along the path due to the lack of displacement of pipe installation, the top-down design which is the component of implemented project in the path is reviewed and investigated after the occurrence of falling in the path of the trench excavation that is adjacent to the sewer pipe of the Besharat main street and due to the lack of liberalization of the infrastructure installations in some parts of the path of project and its plans was announced based on the prefabricated beams method. In this regard, the Zeydon Koush Company in addition to proposing the top-down approach in the form of situ roof, began to the design and approval of the above method.

As it was shown, the application of value engineering methodology can lead to 21% saving in urban underpass project cost. According to the developmental process and a lot of under construction projects of country, there are many projects that in the final stages of construction, has

stalled due to the lack of funds allocation and lose their economic justification. In this context, value engineering technique and consequently, change proposal are useful tools that with purposeful structure and by reducing the construction cost and time also maintaining and promoting the quality of products can help to the projects' timely operation and maintain their economic justification. This issue indicates the capability of this methodology, despite its simplicity. It is hoped that all those involved in this issue try to create significant savings in national capital of Iran by implementing the value engineering in projects of country.

### **Conclusion**

Increasing population growth and consumption of resources and energy in the world indicate the crisis that has revealed the need for resource management to everyone. Given the fact that so many projects in the country were affected by the limitation of financial resources and in some cases even in the final stages of implementation, due to the lack of appropriate financial nutritional requirement of the projects, they have been blacked out and the utilization of methods that minimize the time and cost of project implementation will contribute to the improvement of civil projects of country. Value engineering methodology and value engineering change proposal method are capable management tools and techniques that due to the unlimited demand of resources change the need's satisfying methods and indicate the necessity of utilizing the wisdom and creativity of human. The importance of Value Engineering Change Proposal Method was appeared in answering to two important questions that are proposed on the necessity of applying and benefits of Change Proposal approach for contractors of different civil fields and also industry in the country which can be briefly outlined as following:

- A) The necessity of Value Engineering Change Proposal Method through contractors
- Failure to predict executive factors affecting plans due to the complexity of projects, and the more familiarity of contractors to this type of problems because of more engagement to work
    - Determining some parameters influencing the design at runtime
    - Limitation of implementation technology in relation to the regulations which is discovered and solved by dominance of contractor to the newly implemented technologies.
    - High dominance of the contractor on implementation space and various executive methods
    - Lack of attention to the capabilities and potentials of contractor for implementation of project, because in most cases except the EPC projects, the selection of qualified contractor is done after the completion of the advanced design phase.
    - The time interval of design and implementation is often high in Iran and at the same time, the variations of technology, technical knowledge, aspirations and working conditions vary and these weak values are greatly compensated with motivation of contractor.
    - Synergy of value engineering method and new implementing methods like EPC on one hand and the help of this approach with new factors in projects like project management or fourth agent will provide competent price opportunities for company.
- B) Benefits of value engineering change proposal method for all stakeholders
- The creation of win-win space for employer and contractor compared to the prevailing traditional spaces on implementation
    - Improving the technical ability of contractors in the engineering community: because the contractor by relying on his experience, knowledge and creativity is trying to improve design while in traditional view, the work should be followed under the supervision, control and detailed audit of consultant.

- Creating a systemic space which is based on the law implementation accelerates decision-making process and enriches the contractor's ideas as well as the enhancement of the number and quality of proposals, and the technical power of contractors.
- Promoting the technical ability of contractors with access to the new technologies and creating a positive work environment.
- Continuous improvement of plan along with the reduction of lifetime costs
- The net reduction of contract costs provides this opportunity for them to define and invest their budgets in more projects.
- If change proposal to be repeated, it can convert to the design and implementation conventions in similar projects.
- The change proposal provides the possibility to utilize the experience, creative talent and facilities of contractors for continuous improvement of projects not cross-sectional.
- Obtaining great savings and spending them to maximize the utilization of limited national resources
- The change proposal provides the possibility of expanding the use of new technologies and materials and entering effective technologies through domestic contractors.
- The repetition and frequency of proposals with engineering method by contractors will strengthen the technical knowledge of consultants and employers.

As previously mentioned, change proposal approach has a lot of benefits so that western and American and even some Asian countries have realized the benefits of this methodology and for many years has applied it in required agenda and guidelines for implementation in their executive organizations and organs and benefit from its resources.

However, only the abilities and potentials of a methodology is not enough for its effectiveness. Perhaps how to implement and operate the resources of a methodology is more important than its capabilities. After performing the value engineering workshop and conducted analyses according to the value engineering methodology, the following ideas in 3 general packets of culture making, modification of legislation and institutional and organizational structures and creating financial incentive to enhance the applicability of the change proposal in civil projects of country and to enhance its benefits are obtained which are presented in order of priority and importance and benefits caused by the idea implementation:

### **Recommendations of the study**

This option is based on a relatively comprehensive strategy which by taking into account all dimensions of the problem and without any financial burden on the employer who is trying to solve the problem, is presented in three proposal phases of the creation of culture making, amending the legislation and institutional and organizational structures and creating the fundamental changes, and the creation of financial motivation in contractor. This option descriptively includes following issues: A. The basic actions and studies should be done to disseminate the culture of applying change proposal methodology in civil projects of country. These actions can include all or some of the following issues: holding the training courses directly once in every three month with supervision of the Iranian Value Engineering Association (SIVE), virtual training via the website, holding the promotion conferences annually in government agencies associated with the projects, holding the annual conferences and inviting the national and international experts, expressing the experiences and implementing the table pollen, awarding grants annually to the top change proposal in each fiscal year, the formation of special committees in Iranian Value Engineering Association and specialized organizations, providing the promotional and educational pamphlets, replaying the specialized Value Engineering interviews and interviewing with major managers of country in the

media outlets, introducing the superior examples of change proposal to the executive agencies by posters and brochures that these scenarios would be proposed as change proposal culture making scenario.

B. The inclusion of incentive suggestion in contract based on assigning new contracts to contractor in bidders device, accepting the changes proposal in parallel contracts and considering fee for contractors, the formation of Inspection Committee of Change Proposal in strategic management and monitoring organization of president and compiling the monitoring reports, forcing management organization to get change proposal report from employers for allocation of budget, forcing to use the cost reduction methods like change proposal in project by the employer, requiring consultants to observe the announced times for investigation and announcing opinion, the necessity to establish skilled technical office in the area of Value Engineering in contracting companies' structure, the necessity to introduce value counsel to the employer by the contractor, evaluating the workshop in order to simplify the administrative bureaucracy and shorten the presentation process and investigating the change proposal, creating the change proposal unit by the value engineering method in inspection organization and the appearance of its agents in approval of plans to reduce the responsibility and facilitate the employers, the formation of companies for legal follow-up of change proposal to receive the defined reward, the presence of employer and consultant representatives in value engineering team and the approved of results in the same workshop which these issues can be considered as the scenario of legislation and institutional and organizational structures modification.

C. The creation of financial motivation in contractor can be obtained by the issues such as: paying 50% of reward to contractor when change proposal approved, determining the contractor's participation share from the savings derived from the change proposal presentation in the contract, the approval of the change proposal rewards in executive agencies which is monitored by Value Engineering Association, putting base the contractor's profit reduction by presenting the change proposal as the minimum reward for contractor's assurance, the priority of allocating State budgets to the projects in which change proposal is done. It is hoped that by doing these ideas and opinions at the macro level, country can observe the immediate improvement in the change proposal providing process and increase the benefits derived from it by spending the least possible cost.

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