

The Role of Value Engineering / Value Analysis in Reducing the Cost and time of the Construction Projects

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Abstract: Despite the rapid growth in the construction industry of Iran, housing is still one of the biggest challenges faced by the Iranian government. For instance, the mega construction companies in charge of designing and constructing the second phase of Mehr Housing Plan are in trouble now, because they have not been able to fulfill the requirements of the project in the due time and show the anticipated results. This descriptive survey study underscores the significance of the Value engineering (VE) / Value Analysis (VA), as a systematic project management tool, in optimizing the outputs with reference to cost and time. More specifically, it revolves around the issue of the consequences when VE/VA estimates the ratio of function to cost and crafts a mix of performance (function) and costs. To this end, the perspectives of 68 experienced engineers, directly involved in the Mehr Housing Plan Project, are studied by the researchers to tackle the core issue of reaching the optimum value for both initial and long-term investment in such projects. The results suggest that VE / VA has the potential to clearly define, measure, control and implement the housing projects at any stage of their development, and can, to a great extent, reduce the cost and time of the projects. Therefore, it is suggested that each executive agency establish and maintain cost-effective value engineering procedures and processes.

Keywords: Mehr Housing Plan, Value Engineering (VE), Value Analysis (VA)

1. INTRODUCTION

In recent decade, the Mehr housing project has occupied great time and money of the Iranian construction industry. The project, born in January 2011, started with over \$10.2 billion to provide homeless applicants all over Iran with 600, 000 residential units in its first phase. Close to 400, 000 units have been built and permits have been issued for another 12, 000. Similarly, in the same period the Mehr project was launched in Rasht- Guilan -- which in fact marked the biggest construction project in the construction history of this city as well. This project, situated on a 600 hectare land in the heart of the city, was estimated to complete 25000 residential units by the end of 2013. However, the Scheme did not achieve its desired performance. This has led Iran's ministry of urban development to decide to discontinue the project, and instead launch another project-- the Social Housing project-- to provide housing for the poor.

Admitting that Mehr housing project has not achieved its desired performance in its second phase in Rasht, this research hypothesizes that Value Engineering has a significant potential in changing the plan and cutting time and cost by eliminating or modifying anything that added cost but was not necessary to its basic function.

2. OVERVIEW

Various change management and problem solving techniques have been experienced by the engineers all over the world. However, in almost all, human biases guided both the problem as well as the solution. Therefore, an alternative technique which could address the issue and provide the necessary functions in a project at the lowest cost and least amount of bias was required. Value Engineering (VE) and its subsequent method-- Value Analysis (VA) is the tool [1]. Primarily employed at the design stage, VE / VA is a powerful, systematic and organized approach that focuses on the functions of various components and materials, rather than their physical attributes, and approaches the question of saving cost from the point of view of 'value' [2]. In other words, Value = Worth / Cost, or Value of an item = Performance of its function / Cost, or Value = $\Sigma (+) / \Sigma (-) = \Sigma (\text{Benefits}) / \Sigma (\text{Costs})$, where Value is what the product is worth to the customer; Function is the Properties and qualities of product; and Cost is the Money value of materials used, Labor and indirect costs. Accordingly, for value greater than 1.0, the item is perceived to be fair or having good value. For value less than 1.0, the item is perceived to be having poor value. When an item has a perceived worth that far exceeds the life - cycle cost, we usually consider purchasing the item. An item that does its function better than another, has more value. Between two items that perform their function equally well, the one that costs less is more valuable. This concept resulted into huge savings for engineers, purchasing agents, and service providers.

Although the idea dates back to World War II, it has gained more popularity in the last twenty years and has found a few other names such as Value Analysis, Value Management, Value Planning, Molecular Engineering, and Vertical

Thinking as well. Considering its definition although the term has been defined in a number of ways, all are common in maintaining that VE is an approach that seeks out the best functional balance between the cost, reliability and performance of a product or project [2] [3]. Also almost all [4] [5] [6] claim that VE has benefits of offering lowest cost without detriment to value, quality, performance and reliability.

Unlike the advocates of VE who believe that it is effective in reducing cost and improving the value of construction projects, the opponents do not show such optimism and claim that in reality VE is little more than traditional cost cutting by another name. Thus, this research first examines the issue in the construction industry of Iran and then assesses its role in the savings achieved by them. Finally, it draws overall conclusions and suggestions.

3. METHOD

There are various common performance evaluation techniques: Management by Objectives (MBO) Method; Critical Incident Method; Behaviorally Anchored Rating Scales (BARS) Method; Behavioral Observation Scales (BOS) Method; 360 Degree Performance Appraisal Method; Checklist and Weighted Checklist Method; Graphic Rating Scale Method; Comparative Evaluation Method; Performance Test and Observation Method; Field Review Method; Forced Choice Method; Essay Evaluation Method; and so on [7]. However, as this study intended to examine the factors affecting performance in the Mehr housing project, the Value Analysis/VA model which has been used to evaluate the development projects in different countries was selected for this research purpose.

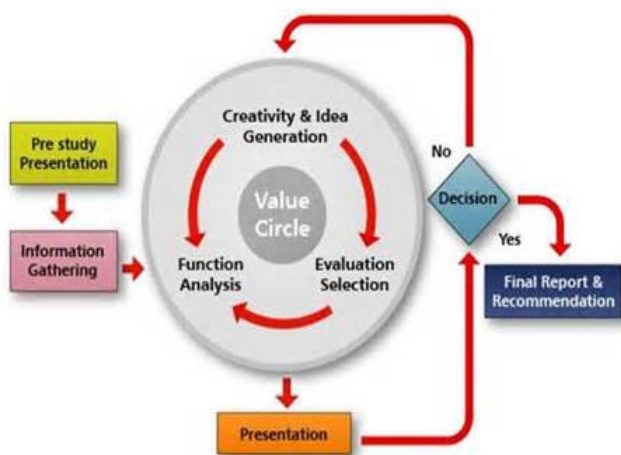


Figure 1. Value Methodology Job Plan used by SAVE (Society of American Value Engineers) International

Accordingly, the independent variables included communication (agreement between the activity and priorities in national development policies), efficiency (inputs are converted effective, useful and efficient to outputs), effectiveness (all of the activities in project which have achieved to desired goal), influence (positive and negative changes caused by development activities, directly and indirectly, favorable or unfavorable) and persistent (durability and sustainability of project benefits after completion of the project), and the dependent variable is the performance of Mehr housing project. The schematic representation of the process is illustrated in figure 1.

As the diagram indicates, the first step in a Value Analysis is to create a Value Methodology Job Plan. The model has six phases:

1. The Information Phase: All available information about the project has to be assembled to develop a better understanding of what is involved.
2. The Function Analysis phase: The function of every item in the project has to be described in detail to develop a detailed understanding of what the project is supposed to accomplish.
3. The Creative Phase: via brainstorming the researcher examines as many alternate ways as possible to achieve the function of the project.
4. The Evaluation Phase: Assesses all of the ideas generated during the creative phase will be narrowed down into feasible alternatives.
5. The Development Phase: Information such as sketches, narratives and specifications is prepared based on the most feasible alternatives to improve the value of the project.
6. The Presentation Phase: The value recommendations will be presented to the Stakeholders of the project.

3.1 Participants. To address the research questions, a total sample of 68 (80.5% Males and 19.5% females) experts and managers in organization involved in the Mehr housing projects in Rasht participated in the study. All the participants were identified through Stratified random sampling method.

3.2 Instrumentation. A questionnaire with Chronbach's Alpha Coefficient ($\alpha > 0.7$) was used to collect data for this study. The distribution of items in the questionnaire is illustrated in Table 1.

Table 1. Distribution of items in the questionnaire

Hypothesis	Predictor Variables		Criterion Variables		
	Title	Question Number	Title	Question Number	
Higher Order	VE	1-30	Cost/ Time	31-50	
Primary	VE	Information	1-6	Cost	31-40
		Function	7-12		
		Creativity	13-18		
		Evaluation	19-24		
		Development	25-30		
Secondary	VE	Information	1-6	Time	41-50
		Function	7-12		
		Creativity	13-18		
		Evaluation	19-24		
		Development	25-30		

As the reliability and validity of the questionnaire and its components VE (Information, Function, Creativity, Evaluation, and Development) and project management (cost and time) were all above .70, the tool was consequently acceptable as the data acquisition device for this study.

3.3 Development of the instrument. The research questions of this study were addressed by the quantitative analysis of numerical data collected using a questionnaire. Considering reliability and validity factors, the development of the measure underwent the VA model used by SAVE (Society of American Value Engineers) International through the following stages. First the required information was gathered to identify the function of the components of the design. Then the monetary value for that function and the necessary function to meet the customers' requirements were defined. As the value of a product might have different interpretations for different customers, this study has defined its common characteristic as a high level of performance, capability, emotional appeal, style, etc. relative to its cost. The cost over the expected life was estimated to add value to the investment so that every element not contributing to the function be eliminated. In other words, $Value = (Performance + Capability)/Cost = Function/Cost$. Then ideas were ranked, and further developed. Having passed these stages, the ideas were ready to be presented. This method has analyzed the process as a collection of functions, which need to be satisfied.

4. FINDINGS

This research intended to examine the relationship between VE and time and cost reduction. Therefore, the correlational

technique had to be employed. As the data were continuous it was decided to use Pearson's correlation. However, the appropriacy of this decision had to be tested against four assumptions. More specifically:

Assumption #1: The two variables had to be continuous.

Assumption #2: The scatterplot created by SPSS had to indicate there was a linear relationship between the two variables.

Assumption #3: No significant outliers would be allowed.

Assumption #4: The variables had to be normally distributed.

Having done the tests, the researchers saw no violation of the first three assumptions. For testing the fourth assumption, a normality test was required. To test the normality of the sample (N=68) for this research purpose, Shapiro Wilks which is recommended for $n = 3$ to 2000 was employed. Results are displayed in Table 2.

Table 2. Shapiro Wilks' Tests of Normality

	Df	Sig.	conclusion
Information	68	.316	Normal
Function	68	.266	Normal
Creativity	68	.199	Normal
Evaluation	68	.321	Normal
Development	68	.239	Normal
Cost	68	.233	Normal
Time	68	.193	Normal

According to the results, the significance value for all components was larger than 0.05. Consequently, they were not significant, indicating the variables were approximately normally distributed. So the parametric Pearson product-

moment coefficient could be used for the analysis. Table 3 presents the results of the relationship between Value engineering / Value Analysis and reducing the cost and time of the construction projects.

Table 3. Pearson product-moment coefficient

		Information	Function	Creativity	Evaluation	Development
Information	Pearson Correlation	1	.772**	.712**	.709**	.844**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	68	68	68	68	68
Function	Pearson Correlation	.772**	1	.780**	.674**	.879**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	68	68	68	68	68
Creativity	Pearson Correlation	.712**	.780**	1	.736**	.917**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	68	68	68	68	68
Evaluation	Pearson Correlation	.709**	.674**	.736**	1	.875**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	68	68	68	68	68
Development	Pearson Correlation	.844**	.879**	.917**	.875**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	68	68	68	68	68

*Note. Correlation is significant at ** the 0.01 level (2-tailed).*

The results indicate significant relationship between VE and time and cost of the project. To decide on the size of the value of Pearson correlation (r) [8] was consulted:

$r = .10$ to $.29$ or $r = -.10$ to $-.29$ small

$r = .30$ to $.49$ or $r = -.30$ to $-.49$ medium

$r = .50$ to 1.0 or $r = -.50$ to -1.0 large

According to the guidelines, there is a large correlation between the variables in this sample, suggesting quite a strong relationship between the variables under investigation. Therefore, the research hypotheses which postulated VE/VA is associated with project efficiency and time and cost cutting were supported. This is in line with similar studies in Iran [9].

5. CONCLUSION & DISCUSSION

On the basis of the results, VE / VA has shown to have the potential to have a significant impact in the success of the plan and cutting time and cost. In other words, VE had a positive role in identifying specific solutions to detailed problems by clearly defining, measuring, controlling and implementing. As VE/VA can be applied any stage of project development, it

can, to a great extent, reduce the cost and time of the projects, suggesting itself as a logical approach in the housing projects.

As it was stated earlier in this paper unlike value itself which is not a new concept, VE as a management methodology based on the value concept is rather recent. However, despite its young age, various studies, this one included, confirmed that it is really cost cutting. So the technique is suggested to be a viable approach in all projects, because every project or process has a function. In addition, it can be applied at any point of the design or process. However, the employment of VE/VA requires the application of a specialized body of knowledge at the right time with the right people. This suggests making appropriate changes in the design of the project could cut the cost and time and make its implementation more effective.

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