Research Journal of Applied Sciences Engineering and Technology 4(8): 962-969, 2012
ISSN: 2040-7467

Submitted: November 09, 2011 Accepted: December 09, 2011 Published: April 15, 2012

Performance Evaluation of Value Engineering Workshops in Iranian Construction Projects: A Case Study

[1]Kimars Fathi Hafshejani, [1]Changiz Valmohammadi and [2]Masoud Saber
[1]Department of Industrial Management, Islamic Azad University- South Tehran Branch, Tehran, Iran
[2]Department of Management/Accounting, Qazvin Branch, Islamic Azad University, Qazvin, Iran

Abstract: This research aims to represent a conceptual model aimed at evaluating the performance of Value Engineering Workshops (VEWs) in Iranian construction projects, given contextual and special conditions of the country. For this purpose four steps were taken; 1-identification of performance criteria for value engineering in construction projects based on literature. 2-application of factor analysis for extraction of main criteria of the performance assessment and recognition of the performance assessment concepts. 3-use of AHP method for comparison of factors. 4-evaluation and ranking of three VEWs. Through a questionnaire and using factor analysis finally 5 constructs and 27 important measures for performance assessment of VEWs were identified. The second questionnaire was designed based on AHP method in order to prioritize 3 VEWs given the criteria identified in first phase of the research and also ranked the same constructs. 4 experts that were working in 3 workshops answered this questionnaire. The results of analyses through Expert choose software showed the order of prioritization of workshops as follows; workshop 3 ranked 1, workshop 2 ranked 2 and workshop 1 in 3rd place. Based on the proposed model, performance evaluation can be done on staff and designers of VEWs and the most important factor affecting workshops can be identified and analyzed.

Key words: Analytical hierarchy process, Iran, performance assessment, structural equation modeling, value engineering

INTRODUCTION

Nowadays viability and success of every organization and project is determined by its ability to compete with rivals and its correct policy making. One of the most effective methods used in this respect is performance evaluation which tries to identify weaknesses and strengths of the system in order to take necessary measures towards removing any possible existing weaknesses. Statistics show that Iran incurs a loss of about $165 million annually due to lack of an appropriate and efficient evaluation and utilization system regarding national plans. These losses and delays in initiating national plans led the Iranian authorities of Management & Planning Organization (2001) to employee value engineering to minimize these costs.

The VEW process involves several important elements, including teamwork, functional analysis, creation, cost-worth, and the systematic application of a recognized technique. The incorporation of these elements into a VEW job plan distinguishes the VE approach from other cost-cutting exercises. Without these elements, the process is not VE and does not yield the same results (Federal Highway Administration, 2008). The success of the VEW depends on several factors:

- VEW job plan execution
- VEW team leader's personality
- Client input
- VEW plan and relationships within the design team
- the nature of the project itself (Palmer *et al*., 1996; cited in Chen *et al*., 2010)

When establishing a VEW performance assessment model, the aspects and criteria used to measure the performance should be selected, and the interrelationships between aspects and criteria should be identified (Chang and Chen, 2004).The Iranian management and planning organizations in order to create and spread the culture of Value Engineering (VE) among Iranian industries compiled a series of rules and regulations in the year of 2000 (Management and Planning Organization, 2001). So given the context and special conditions of the country the aim of the study is to represent a conceptual model that is able to evaluate the performance of construction Value Engineering Workshops (VEWs) in development projects. In other words the main objectives of this study are triple;

- Identification of performance criteria for value engineering in construction projects

Corresponding Author: Changiz Valmohammadi, Department of Industrial Management, Islamic Azad University-south Tehran Branch, Tehran, Iran

Table 1: Definitions of the 34 measures

No.	Criteria	Definition
1	Leading VEW experiences the team leader	The intrinsic experiences and knowledge of The VEW team leader is vital to the of success of the workshop.There is little margin to accommodate errors during the VE workshop. High quality leadership is a good start of a successful VEW.
2	The team' s commitment to VEW	Commitment of team members to rules and regulations of VE and responsibilities assigned to them.
3	Professional level of VEW team members	The professional level of VEW team members is supposed to be better than or, at least, equivalent to that of the original designer. Because VEW study itself is an improvement process, it is highly recommended that the expertise of the VEW team is to be better than the original designer to improve the existing design.
4	Integration and coordination ability of team leader	A VEW team leader works in a multi-disciplined environment; synergy is well achieved only when the highly professional team is well coordinated and the expertise is integrated
5	Team leader's ability to control job plan and schedule	VEW itself is a tight project with several constraints on resources. A dynamic control in the workshop is required. VEW team leader's schedule management and job plan controllability is vital to the success of VEW and a challenge to a VEW team leader.
6	Attendance stability of VEW team member	The basic function of a VEW is to focus on the synergy of the multi-disciplined experts. Stability of team participation is a linchpin to achieve the function. In terms of time and human resources input, team expertise does not only help identifying functions of the study objects, but also generate creative ideas through frictions of expertise discrepancies.
7	Representing level of designer	There are two interfaces with the designers in a VEW. One is in the information phase, where the designer briefs the VEW team and expresses the original design concepts as well as design details. Another interface is in the recommendation phase, where the VEW team proposes their recommendations after an intensive workshop. The representing level of the designer is important to the VEW.
8	VEW experiences of designer	There are some situations in VEW implementation in regards to the designer. One is that VEW is under the contract of the designer. For example, a VEW is under the contract of the detail design consultant (DDC) and the study objective of VEW team involves the basic design of the previous designer. In this situation, the experience of DDC in conducting VEW is very important.
9	Team leader' s ability to resolve differences and disagreements of team members	Value engineering is a creative project, and many theories are offered by the engineering team. Owing to the training and experiences that team leader has already held, the leader should survey different views and existing disagreements and be able to offer the best solution.
10	Intention of owner conducting VEW	This item represents the level of willingness/intention/desire of the owner executing VEW. Generally, when the results of VEW are linked to the measurement of performance, the intention of the owner is stronger.
11	VEW acceptance level for design unit	A successful VEW is measured by the implemented savings of the recommendations. The designer plays a key role in carrying out the accepted recommendations. When a designer highly recognizes the efforts of the VEW, then the chances of a successful VEW is relatively enhanced.
12	VEW costs	An agent will maximize the benefits of the owner only if the agent is well compensated. Some owners have the misconception that VEW expends no resources. Adequate fee/expenses are required to generate satisfactory results.
13	VEW implementation timing regarding construction project life cycle	The early implementation of VEW is critical to the potential savings. The earlier the VEW is conducted, the bigger the potential savings that can be achieved.
14	Duration constraint of VEW implementation	The study length duration and schedule of VEW is subject to the availability of VE team members, and the urgency of the design schedule. Normally, less impact on the design schedule is preferred. Therefore, design schedule and the length duration constraints of VEW execution must be taken into account.
15	Cooperation of VEW team member	It is always a hard task to create a cooperative and mutual supportive environment in a team. Support and cooperation of VEW team members is also a foundation to focus team synergy.
16	Frequency of team member change	In a VEW, some team members might not be the same calibre because of the logistical reasons Human resource is a fundamental resource in a VEW, and frequent changes of team members might result in poor impact on the VEW performance.
17	Communication, coordination and consensus level during VEW	Theoretically, consensus has to be achieved because the functional, judgment, and recommendation phases all require team consensus to proceed to the next stage because the FAST diagram is completed only when team consensus is reached. Screening, selecting, merging and discarding of the created ideas and recommendations also require team consensus. When the result of a VEW is substantial and being accepted.
18	Interaction among VEW team, owner and designer during VEW	This factor discusses the interactions within VEW and with outside stakeholders.The higher the score of the factor, the higher is the level of team dynamism evoked.
19	Completeness of job plan	VEW job plan is the roadmap which leads to the success of the workshop. A complete and sound job plan avoids or decreases risks of a VEW.
20	Project scope clarity	Clear definition of the scope and study objective is important for the project scope management. The nature of VEW is always under a tight schedule and under relatively high pressure. Clarity on scope and study objective definition avoids misleading of team's study directions and thus allocates resources at the right spots.
21	Project complexity	A complex project comprises several systems and requires substantial domain knowledge in order to conduct the VEW.
22	Appropriate workshop executing progress	The progress of each phase can be estimated based on the Value methodology published by SAVE International and the job plan of VEW. The rate of progress is influenced by project complexity, fluency with value methodology of the team leader and team formation. When the progress is faster or slower than planned, it might imply that some phases are being omitted or skipped.
23	Completeness of meeting minutes	This item represents the detail level and decision process of VEW records.

Table 1: (Continued)

24	Number of recommendations	A greater number of recommendations are an indication of more outputs of VEW. This is achieved when the VEW team is properly formed and the adherence to the six-phase job plan is well maintained.
25	Completeness and clarity of recommendations	A recommendation should include descriptions, function definitions, advantages, disadvantages, original cost information and proposals (including savings). In other words, technical and financial packages of the original and proposed recommendations as well as risks should be clearly included. Additionally, a complete recommendation will greatly facilitate the decision making on the recommendations.
26	Proposed savings amount and saving percentage	Taking life cycle costs into account, proposed savings are claimed by VEW. There is a discrepancy between proposed savings and implemented savings which might not be easy to calculate.
27	Return over investment	ROI is a ratio of savings generated versus resources input.
28	Constructability of recommendations	This PAC represents the recommendations contribution to the constructability of the project.
29	Recommendation Supports of designer	This PAC represents the level of recognition and acceptance of the designer on the proposed recommendations.
30	Designer's satisfaction with six-phase job plan	This PAC represents the level of satisfaction of the designer with the six-phase job plan. The documentation of a VEW six-phase job plan adhering to acceptable standards is of great value to the designer for the implementation of the accepted recommendations and the development of the follow up design.
31	Team leader's satisfaction with six-phase job plan	Some VEWs might not be led by a CVS. The PAC represents the level of satisfaction of a CVS with the six-phase job plan.
32	Designer's satisfaction with workshop goal	This PAC represents the level of satisfaction of the designer with the degree of achievement of the goals of the VEW. Generally, the goals of a VEW are: savings percentage, profit increasing percentage, increasing customer satisfaction, enhancement of internal process performance and enhancement of staff learning, innovation and ability.
33	Team leader's satisfaction with workshop goal	In terms of the interests of the designer, the goals that might be taken into account are: the percentage of savings if the project has cost overrun, magnitude of design change and schedule constraints.
34	Support of senior managers who are employer of the projects for VE team activities	Value engineering is a creative project. Group working is the spirit of value engineering. In a value engineering project the managers suggesting the work should completely support it.

- Identification of the main performance criteria using factor analysis
- Ranking of VE evaluation criteria and VEWs using AHP technique

LITERATURE REVIEW

VE is an organized application that uses a combination of common sense and technical knowledge to locate and eliminate unnecessary project costs. Applying sound VE principles can effectively reduce costs and thus enhance project value (Chen *et al*., 2010). The VE concept evolved from the work of Lawrence Miles who, in the 1940s was a purchasing engineer with General Electric Company (GEC) (Kelly and Male, 1988). From its origin in manufacturing, VE/VM quickly spread to other industries, including construction, in the 1960s. Other countries adopted its application in the 1970s (Kelly *et al*., 2004). The workshop approach used for VM aims to exploit the synergistic benefits derived from gathering relevant project stakeholders together as a group. It is typically based on the methodology proposed by SAVE International (SAVE International, 2007; cited in Bowen *et al*., 2011). Value engineering in the construction industry is a process in which a project is reviewed by a qualified study team with the goal of eliminating unnecessary costs while maintaining the project's function, quality and owner's vision. Furthermore, it is important for everyone participating on the study team to understand that this process is not an unorganized critique of the designer's plans, but an organized system in which the team approach is used to provide creative solutions and alternatives to the project that will eliminate unnecessary costs (Mansfield and Inyang, 2006). Since its introduction in the 1950s in the United States, VE has been employed effectively in numerous countries around the world. The worldwide use of VE has attracted interest from both researchers and practitioners in studying the use of VEWs in construction. According to Leung and Wong (2002), performance directly influences organizational efficiency and effectiveness. The use of appropriate methods of performance assessment could fulfill the educational requirements of organizations and individuals and boost the cost effectiveness of training. Although a VEW team is a project-based temporary organization, its goals are the same as those of ordinary organizations. Therefore, it is important to assess the performance of the VEW team by examining efficiency, effectiveness, team capabilities, and degree of customer satisfaction. The outcomes of the performance assessment can offer valuable feedback to future VEWs (Chen *et al*., 2010). Farajian Hazartloo (2010) in a research regarding the expansion of value engineering in irrigation and drain networks using strategic planning models, e.g. QSPM and SWOT took a measure to analyze ideas and select implementable ideas. The results from generalization of evaluation and strategic planning model in irrigation and drain networks value engineering in Qaresu region suggest that through these models, ideas and thoughts created in creation phase can be analyzed and those with higher priorities can be used towards the extension and expansion of value engineering in irrigation and drain networks. Also the results suggest that this method can be used as one of scientific and support techniques in value engineering phase in irrigation and drain networks given the numerous available factors. Chen *et al*. (2010) in a research on general evaluation of value engineering workshops in development projects add to the existing knowledge by presenting an evaluation model based on work plan for measuring VEWs performance.

In order to meet the objectives of this research, initially by studying literature review such as (Chen *et al*., 2010; Farajian Hazartloo, 2010; Sebt and Parvaresh, 2009; Kelly *et al*., 2004) 34 criteria were identified as VEWs performance which along with their explanations are shown in Table 1. These criteria were used to design the questionnaire of phase 1. Validity of this questionnaire was confirmed by 3 members of value engineering society experts.

RESEARCH METHODOLOGY

In this research, descriptive statistics indices e.g. central indices (mean, mode and median) and dispersion indices (standard deviation and variance) were used in order to study respondents' characteristics. Also, in order to analyze research data, one sample t- test was used for identifying research variables' state and exploratory confirmatory factor analysis and structural equation modeling were employed to assess measurement model's variables. To perform these analyses, statistical softwares SPSS 17 and LISREL 8.54 and in order to analyze paired comparison of performance evaluation dimensions and comparison of workshops, software Excel were employed.

Statistical population and Statistical sample: Statistical population for this research consists of all specialists, designers and staff of value engineering workshops and all ones who are involving in development projects. As the ratio of $n/N<0.05$ provides support so the research population was considered unlimited. Also regardless of the population distribution, according to central limit theorem, distributions of sample mean and sum are normal. Based on Morgan table, number of statistical sample members is estimated 250. In other words when statistical population approaches infinity, number of sample members does not exceed 250. It should be indicated that number of sample members obtained in this way is considered as lower bound of sample, i.e. the number of samples should not be less than 250. In this study the required sample was obtained from 2 groups. Group 1 consists of researchers and group 2 is staff and designers of value engineering workshops.

Researchers group: About 130 questionnaires were distributed and finally 60 ones were collected and analyzed (response rate: 46.1%).

Staff and designers group: About 120 questionnaires were distributed among staff and designers being members of value engineering society , counseling engineers and engineers of Tehran municipality engineering office and finally 39 questionnaires were collected and analyzed (response rate : 32.5%).

In sum, the number of sample members was 250 in this research which 130 members were value engineering researchers and 120 ones were staff and designers of value engineering workshops. It should be noted this study was conducted in Tehran and the data collection took about two months from April 2011 to June 2011.

RESULTS AND DISCUSSION

Analysis of the questionnaire phase one:

Descriptive analyses: About 84% of respondents were male and the rest were female. About 27.3% 0f respondents held a bachelor's degree, about 58.6% master's degree and about 14.1% a doctorate degree. 46.5% of responders had less than 10 years about 40.4% between 10-20 years and 13% had more than 20 years of work experience.

Inferential analysis: In order to examine the state of research variables one sample mean statistical test was used. In order to prevent interference with research hypothesis, each proposition was stated as a question. Hypothesis o in all research variables given the 5-point Liker scale is as follows:

$$H0: \mu = 3 \quad H1: \mu \neq 3$$

The hypothesis was proposed in a form that whether the mean point related to each variable equals to 3 or not. Given the fact that all questions of the questionnaire were formulated directly, the mean obtained in the range of 3-4 implies the item is important and in the range of 4-5 implies the item is very important. In this research the questions that their means are more than 3 i.e. important, are considered in analyses and the rest ones are eliminated.

p-values and t-statistics of the following measures were in an acceptable range and consequently these questions are relatively very important:

- Leadership experiences (leader of value engineering workshop team)
- Commitment of team to value engineering workshop
- professional level of engineering work shop team members
- Ability of team leader to integrate and coordinate
- Team leader's ability to control work and schedule
- Stability of team members attendance
- Value engineering workshop designer experience
- Ability of team leader to resolve conflicts
- Acceptability level of value engineering workshop for design unit
- Engineering workshop implementation scheduling in relation to life cycle
- Cooperation of value engineering workshop team members
- Team members' frequency

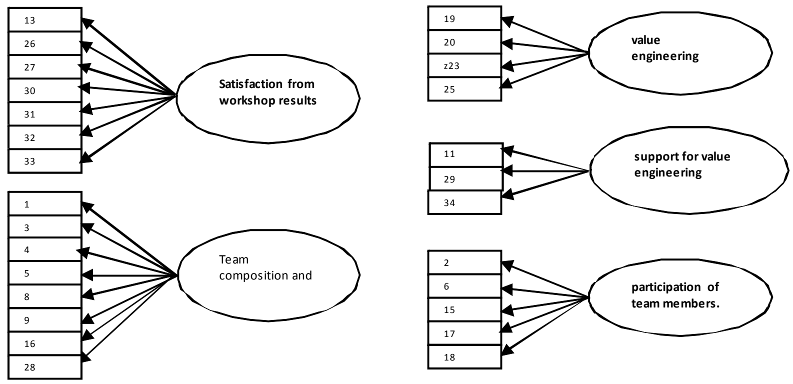

Fig. 1: Conceptual model of research

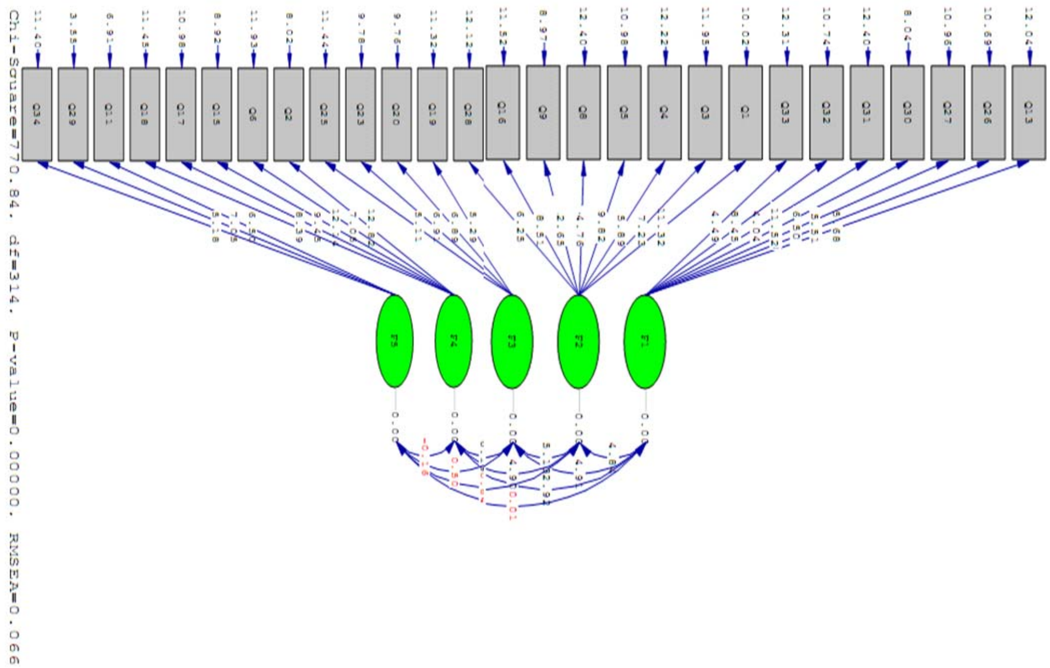

Fig. 2: Measurement model of variables in standard estimation state

Table 2: Kaiser-Meier and O .Klein Bartlett tests

Measurement of sample adequacy of Kaiser Meier		0.861
Bartlett's test of sphericity	Approx. Chi-square	528.014
	df	351
	significance value	0.000

- Level of consensus, coordination and communication during value engineering workshop period
- Interaction between value engineering team owner and designer during value engineering workshop period
- Completeness of work plan
- Clarity of project scope
- Completeness of agendas
- Completeness and clarity of recommendations
- Saving amount and suggested saving percent
- Return on investment
- Capability of constructing recommendations
- Recommendation support of designer
- Designer’s satisfaction from 6 phase work plan
- Leader’s satisfaction from workshop goal
- Leaser’s satisfaction from 6 phase work plan
- Designer’s satisfaction from workshop goal
- Support of senior managers who are employers of the project for activities of value engineering ream and also p-values and t-statistics of the following questions were not at an acceptable level which means that they are of little importance and were eliminated from the questions
- Designer’s representation level
- The intent of owner or director of value engineering workshop

- workshop costs
- Implementation period limitation of value engineering workshop
- Project complexity
- Appropriate progress towards workshop implementation
- Recommendations number

output of software through the test of research question using structural equation model shows that the fitted model is appropriate to test the hypotheses (ratio of $X^2$to

df is below 3) thus X^2 value is a proper and low value. Also RMSFA=0.66 shows that the structural model fitness is appropriate. The observed data are consistent to the conceptual model to a great degree.

Exploratory factor analysis: Factor analysis is mainly used for reduction of data. The aim of data reduction is to eliminate extra variables from data file and the aim of structure identification is to study the latent relationship between variables. This method addresses the internal correlation of a great deal of variables and finally sorts them in to general limited factors and explains them. Factor analysis can be performed in 2 forms of exploratory factor analysis and confirmatory factor analysis (Momeni and Faal Qayyum, 2006). In this research confirmatory and exploratory factor analyses were used in order to identify latent variables and ensure accuracy of measurement model. Measures 7, 10, 12, 14, 21, 22 and 24 were eliminated in mean test of population and totally 27 effective measures remained. Then latent variables were confirmed using exploratory factor analysis and accuracy and fitness of them were discussed using confirmatory factor analysis. Factor loadings above 0.5 were considered (Houman, 2009). Rotated Varimax was applied for the interpretation and identification of factors. If the value of KMO is less than 0.5 data would not be appropriate for factor analysis and if it s value is between 0.5 and 0.69 factor analysis can be done more cautiously but if its value is greater than 0.70 correlations between data would be appropriate for factor analysis (Momeni and Faal Qayyum, 2006). At first in order to ensure that data are appropriate respecting the adequacy of sample for exploratory factor analysis Kaiser-Meier and Bartlett tests were used. Sample adequacy value (KMO) and also Bartlett sample sphericity significance test were 0.861 and 0.000 respectively.

Given the KMO significance value is greater than 0.7 (Table 2) and Bartlett test significance value of 0.05 (sig<0.05) it can be inferred that data are appropriate for factor analysis. These 27 measures were loaded into 5 constructs which are shown in Fig. 1. 79% of total variance is explained by these 5 constructs.

Figure 2 shows measurement model of research variables in standard estimation state. Results of estimation suggest relative suitability of indices. Given the Lisrel output the calculated value for X^2 equals 770.84 which relative to degree of freedom (314) is less than 3. ARMSE Value is also equal to 0.066. Permissible limit for ARMSE is 0.08. Indices AGFI, GFI and NFI are respectively equal to 0.91, 0.93, and 0.96 which show relatively large fitness. Factor loading shows the correlation degree of each observable variable (measures of the questionnaire) with latent variable (factors). In Fig. 2 factor loadings of each measure can be observed. For example factor loading schedule of VEW implementation measure explains 13% of variance approximately. 0.87 is error value (variance percentage is not explained by first question it is obvious that the lower the error value is the higher the determination coefficients would be and the more correlation exists between the question and related factor). The value of determination coefficient is between 0 and 1 by progressing towards 1 variance explanation increases. The above-mentioned questions were tested and finally the relationship between them was determined. We considered some criteria in order to evaluate performance of workshops and distributed them in the form of a questionnaire to statistical population and finally the answered questions which their means were higher than 3 were considered as important and remained in analysis and other questions with a mean less than 3 were deleted.

Factor rotated matrix includes factor loadings of each variable on factors remained after rotation. The more the absolute values of these factors are , the greater is the role of the related factor in whole variation (variance) of the intended variable. According to factor rotated matrix, it can be seen that 5 constructs were identified as the main factors. Factor rotated matrix shows that which measures are loaded to each factors. Based on the topic of the literature these five remaining factors were named as follows:

- Satisfaction from workshop results
- Team composition and coordination of capabilities
- Value engineering workshop plan
- Support for value engineering workshop
- Participation of team members

Confirmatory factor analysis: On the examination of each model the main question is that whether this measurement model is appropriate or not, in other words if research data are consistent with conceptual model. Generally, two types of indices exist for testing model fitness:

- Goodness indices
- Badness indices

Goodness indices, for example AGFI, NFI, etc, are better when their values are higher. The recommended value for such indices is 0.9, Also badness indices including X^2/df and RMSEA suggest better fitness of model when they are lower Permissible limit for X^2/df is 3 and permissible limit for RMSEA is 0.08. Questions of good and bad (df/2χ, RMSEA AGFI, AGFI, NFI, CFI)model should also be examined (momeni and Faal Qayyum, 2006). In order to analyze data collected for this research as mentioned earlier, firstly at descriptive level demographic features of sample members e.g., gender, education, age and resume were described and summarized using statistical indices and then at inferential level research questions were addressed using one sample t-test.

CONCLUSION AND PRACTICAL IMPLICATIONS

Based on results obtained in paired comparisons, there was an acceptable consistency. According to the performed evaluation the priority order of workshops is as follows:

- Workshop 3
- Workshop 1
- Workshop 2

workshop 2 <workshops 1 <workshops 3

Thus, factor (dimension) 1 of value engineering workshop plan obtains the greatest point, factor (dimension) 3 i.e., participation of team members obtains the second rank and factor (dimension) 2, support for value engineering workshop and factor (dimension)5, teams composition and coordination of capabilities ranked 3th and 4^{th} respectively. Finally factor (dimension) 4, satisfaction from workshop results is placed at the bottom of the importance.

factor 4 <factor 5 <factor 2 <factor 3 <factor 1

According to the results obtained from comparisons regarding VEWs, work plan is the most important measure and this dimension of workshop should be regarded the most . Given the fact that value engineering and value creation for products, projects and other services has turned the focal point of many factories and projects, various kinds of savings have been realized in this way in many different areas of VE\VM projects (Bowen *et al*., 2011), public service affairs (e.g., dams building).nowadays choosing proper site for implementing projects through VE are among the top activities of employers and executives. Some practical implications resulting from this study are as follows:

Based on the proposed model performance evaluation can be done on staff and designers of VEWs and the most important factor affecting workshops can be identified and analyzed through a ranking scale ranging from very effective (5) to least effective (1). According to the results obtained from decision makers in this research we concluded that regarding work plan of VEW, workshop 3 had the best plan in a way that all project scopes had been clearly explained. On the measure of recommendation supports of designer, workshop 2 obtained the best rank and this indicates the highest level of support in this workshop. Regarding measure of participation of team members, also workshop 3 had the most participation rate and its members and designers had an active presence in running workshop. On the measure of satisfaction from workshop results, workshop 3 obtained the best results from employers and designers viewpoint. And finally given the measure of team composition and coordination of capabilities, workshop 3 had the best composition and capability. It should be mentioned that VE is a creative and collective phenomenon, so in order to increase the likelihood of VE successful implementation, team leaders of VE should encourage all members of the team to actively participate in the workshops and collect the opinions of all members and choose the best one. In order to assess the generalizability of the model it is recommended the proposed model of this study to be applied in other country's workshops. Also it will be useful to study regarding the identification of the suitable infrastructures necessary for successful implementation of the proposed model.

REFERENCES

Bowen, P., K. Cattell and I. Jay, 2011. Value management in the South African manufacturing industry: Exploratory findings. Manage. Decis., 49(1): 6-28.

Chang, P.Y. and W.T. Chen, 2004. Evaluating the performance of VE study using factor analysis and AHP. Proceedings of SAVE International 44th Annual Conference, Montreal, Canada.

Chen, W.T., P.Y. Chang and Y.H. Huang, 2010. Assessing the overall performance of value engineering workshops for construction projects. Int. J. Project Manage., 28: 514-527.

Farajian Hazartloo, M., 2010. Investigating Frameworks of Expansion of value Engineering in Irrigation and Drain Networks. Research Plan, Islamic Azad University-Science Branch, Tehran.

Federal Highway Administration, 2008. The Value Engineering Process. Retrieved from: http://www.fhwa.dot.gov/ve/veproc.cfm.

Houman, H.A., 2009. Structural Equation Modeling Using Lisrel Software. 2nd Edn., Samt Publication , Tehran.

Kelly, J. and S. Male, 1988. A Study of Value Management and Quantity Surveying Practice.

Kelly, J., S. Male and D. Graham, 2004. Value Management of Construction Projects, Blackwell, Oxford.

Leung, M.Y. and K.M. Wong, 2002. Value elevation by the evaluation of behavioural facilitation skills", Proceedings of SAVE International 42nd Conference, Colorado, USA, pp: 139-145.

Management and Planning Organization, 2001. Annual Report.

Mansfield, S. and P.D.U. Inyang, 2006. Application of Value Engineering within the Construction Industry. ASC Proceedings of the 42nd Annual Conference Colorado State University Fort Collins, Colorado.

Momeni, F. and A. Qayyum, 2006. Statistical analysis using SPSS. Ketabe No Publication, Tehran.

Sebt, M.H. and K.E. Parvaresh, 2009. Practical Application of Value Engineering on Design, Construction and Utilization. Publication of Amir Kabir Industrial University, Tehran.