



Enhance using Value Engineering Techniques in construction industry by questionnaire survey analysis

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المخلص العربي:

هندسة القيمة (VE) هي منهجية حديثة أثبتت أنها طريقة إدارة مهمة لتحسين التخطيط والتطوير وفعالية التكلفة في العناصر المختلفة للمشاريع الهندسية. تعد هندسة القيمة واحدة من أكثر الاستراتيجيات فاعلية والمعروفة للكشف عن التكاليف التي يمكن التخلص منها في تصميم المنتج والبحث والإنتاج والتطوير دون التأثير على الوظائف الأساسية المراد تحقيقها. هندسة القيمة (VE) أثبتت أنها طريقة مهمة لإدارة وتحسين التخطيط والتطوير وفعالية التكلفة في العناصر المختلفة للمشاريع الهندسية. يعكس الاستبيان الذي يعتبر الحالة البحثية لكيفية قيام الباحث ببناء وتطوير مصداقية وموثوقية الاستبيان. بشكل عام يعرض هذا الجزء المنهج العلمي الذي اتبعه الباحث لاكتشاف بعض الإجابات المنطقية على الفرضيات والأسئلة الرئيسية لهذه الدراسة.

Abstract:

Value Engineering (VE) is a feature methodology that has proved to be an important management method for optimising planning, development and cost-effectiveness in the different elements of the construction projects. Value Engineering is one of the most effective strategies known to detect and remove excessive costs in product design, research, production, development, service, repair, records, procedures and practises. Value Engineering (VE) is a feature methodology that has proved to be an important management method for optimising planning, development and cost-effectiveness in the different elements of the transport programme. A questionnaire survey which is considered the case study is reflects how the researcher built and developed the validity and reliability of the questionnaire. Overall, this part presents the scientific method followed by the researcher to find out some rational answers to the main hypotheses and questions of this study.

Introduction

Value Engineering (VE) is a systemic method of optimising the value of objects or services and products by means of a feature search. VE (value engineering) was established by General Electric Corp. among the Second World War and is commonly used in government and industry, especially in some areas as military, health field, transportation, construction sector.

Value, as described, is the function-cost ratio. Value may then be improved either by optimising the feature or by reducing costs. It is the key principle of value engineering whereby the fundamental functions are retained and not diminished as a result of the increase of value.

Value Engineering (VE) within the building industry is a coordinated mechanism to study a project with the intention of reducing excessive costs within the project. Dell'Isola[1] describes needless project costs as any component that does not have the quality, usage, life, appearance or consumer characteristics of the project. Although the reduction of unnecessary costs by undertaking systematic value engineering studies has been seen to be effective in government-funded construction projects, the owners of small-scale private construction projects seem hesitant to accept the value engineering method.

VE analysis is a comparatively recent system that traces its history back to the late 1940s. The idea was invented by Lawrence D. Miles[2], author of Value Measurement and Engineering Techniques. It is a framework designed to minimise excessive costs. Value Analysis and Value Engineering is intended to better explain the unique methods in value analysis, to learn the value analysis work plan, to determine the core variables in value analysis, and to understand the role of value expert compared to the rest of the business.

The rationale behind value engineering is as follows: if advertisers intend a commodity to become functionally or stylishly redundant within a given timeline, they will plan it to last only for that particular timeframe. The goods may be made with higher-grade parts, but with performance engineering they are not because this would place an excessive expense on the producer and, to a small degree, raise the cost on the purchaser. Performance engineering is going to reduce these costs. Usually, a manufacturer would use the least expensive materials that meet the product's lifetime projections.

The aim of the VE thesis is to achieve excellence in architecture. The VE team is searching for an optimal balance of preparation, efficiency, design, sustainability, environmental awareness, safety and cost-consciousness. The VE process is not intended to critique today's designs or insinuate that the regular road design process does not have suitable designs. The designs that are being designed today are good plans, they can be constructed, and they will perform as planned. The aims of the research are as follows:

- Apply value engineering techniques to building work sites/industry in order to gain cost efficiency, reduce construction time and improve safety.
- Description to define fields where value engineering can be used to increase the efficiency of building.
- Describe the value and benefits of VE

Literature Review:

Value Analysis is an important subject to be explored, especially in the field of engineering. A variety of literatures have been discussed, emphasising the relevance of value engineering in all fields. During the Second World War, the Value Engineering Method was invented by Lawrence Miles[3], an electrical engineer for General Electric Company, in response to resource shortages produced during the war. The war effort involved the manufacture of goods, but the scarcity of supplies compelled the specification of various materials.

Lawrence Miles found that many of the items manufactured using the substitution materials served the equivalent function of the existing ones at a reasonable cost. The literature on the implementation of value engineering is discussed here. Apurva[4] studied Value Engineering in the Building Industry. This paper introduces the fundamental concepts of Value Engineering and its various phases that can be applied in every building sector in general in order to maximise its value. The content is selected in such a manner that the expense is minimised without compromising the performance and design of the component.

Building –Case Study. They introduced engineering principles in a residential building. The interpretation of Pareto Law 20/80 specifies that about 20% of the functions cover around 80% of the costs. These (20 per cent) functions are the focus of value engineering. They also noticed that the first 6 items (out of 16) account for 61.53 per cent of the overall expense. In conclusion, the field of Value Engineering Research and Review will be dominated by the first six functions. They also said that we should evaluate these functions and propose alternatives and measure the cost model after the implementation of the value engineering methodology.

A further research on Value Engineering in Highway Construction by Sayali Dhayalkar and Hemanshu Ahire[6] addressed the idea of Value Engineering and the successful execution of the road construction programme. According to their interpretation of Pareto Law 20/80, about 20% of the functions cover around 80% of the costs. These (20 per cent) functions are the focus of value engineering. It was also noticed that the first 3 products (out of 13) account for 73.3 per cent of the overall expense. In conclusion, the field of Value Engineering Research and Review will be dominated by the first three functions.

Stephen Mansfield and Philip D. Udo-Inyang,[9], Value Engineering Implementation inside the Construction Sector The current understanding and application of value engineering was developed by means of a survey questionnaire sent to different members of the construction industry asking specific questions about the participants' expertise and experience in value engineering.

Results were analysed which showed that the majority of survey respondents did not engage in value engineering studies and did not understand the true definition of value engineering, although eighty-four percent of respondents said that value engineering was carried out on projects on which they were members of the project team.

Research Methodology

The researcher used the descriptive analytical method to achieve its objectives, which depend on the study of the phenomenon as it is in reality. This method hinges on producing accurate description of the topic studied in qualitative and quantitative approaches. On the other side, the quantitative approach is also implemented through collecting information by spreading the questionnaire on the targeted sample in order to investigate the issue's manifestations, its different relations, Analysis, interpretation and access to conclusions based on the proposed scenario so as to increase the balance of knowledge in this study.

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This study was conducted by taking a deductive approach into consideration. Throughout this strategy, the researcher begins with stating the study hypotheses in order to collect guidelines that enable him to extract the final results. Then, these results can be used to confirm or reject the hypothesis stated. This study deals with the analysis of numerical data by means of several statistical calculation methods.

The study tool's validity and reliability are important features which give the research its credibility. Validity as a research term refers to the degree to which the questionnaire parts including the questions and sentences are inclusive and cover all the hypotheses or not. On the other side, reliability means the accuracy and uniformity of the measurement tool when applied in the same conditions and manner of doing it many times later.

And For Data Collection Tools, we depend on a questionnaire containing 3 main dimensions :(Pre-workshop factors- Workshop factors- Post-workshop factors) and for Statistical techniques include the following:

1. Frequencies, percentages and graphs
2. Mean, Standard deviation (STD).
3. T test

Questionnaire and Data analysis

The researchers evaluate the dimensions of the survey, to see the truth of these dimensions when the study population, with the following findings using the T test for each sample (One Sample T test), to see whether or not the arithmetic average of the degree of answer of each paragraph of the questionnaire is equal to 3 degrees of neutrality, if the value of (p-value) (sig) is greater than the significant value of (p-value) (sig), In this situation, the opinions of the sample population approaching the level of neutrality are 3, and if the value of (p-value) (sig) is lower than the level of

significance, in this case it can be determined if the average response increases or decreases the degree of neutrality, by means of a reference value if the reference test is positive, that means the arithmetic mean of the response over the degree of objectivity, a 3 and Conversely, the findings of the research dimension review can be described by the following:

The descriptive Statistics Std. deviation, T test for Pre-workshop factors.

Table (1) the descriptive Statistics, mean Std. deviation for Pre-workshop factors

item	Mean	Std. Deviation	relative weight	t test	sig
Clear objectives of workshop	4.55	0.605	8.784	11.461	0.000
Client's participation	3.65	1.424	7.046	2.041	0.055
Client's support	3.80	1.152	7.336	3.107	0.006
Disciplines of participants	4.75	0.444	9.170	17.616	0.000
Qualification of facilitator	4.75	0.550	9.170	14.226	0.000
Relevant stakeholders' support	3.75	1.410	7.239	2.380	0.028
Fulfillment of the period when the VE Workshop will be implemented	3.35	0.813	6.467	1.926	0.069
Years of professional experience of participants to apply VE using BIM	3.05	1.317	5.888	0.170	0.867
Years of experience of facilitator (VE/BIM specialist)	4.60	0.681	8.880	10.514	0.000
Qualification of facilitator (VE/BIM specialist)	4.65	0.587	8.977	12.568	0.000
Number of pre-workshop meetings held.	3.40	1.314	6.564	1.361	0.189
Time spent on preparation before workshop.	3.45	1.468	6.660	1.371	0.186
Number of related documents analyzed	4.05	0.759	7.819	6.185	0.000

According to the previous table, it can be concluded that:

The responses of the sample show Moderate important towards the dimensions “Pre-workshop factors”, where mean is 3.98 while its standard deviation is 0.93 and that means the responses is Concentrated on its mean, so the trend of the sample responses towards the dimensions is “agree”. Regarding to T test we can say that most of the statements have significant difference than 3, which mean that there are difference trends of the sample towards these statements.

The descriptive Statistics mean Std. deviation, t test for Workshop factors.

Table (2) the descriptive Statistics, mean Std. deviation for Workshop factors.

item	Mean	Std. Deviation	Relative weight (%)	t test	sig
Background information collected	4.35	0.813	10.093	7.429	0.000
Client's objectives clarified	4.80	0.410	11.137	19.615	0.000
Communication between stakeholders in each process	3.85	0.933	8.933	4.073	0.001
Primary functions/processes identified	3.75	1.020	8.701	3.290	0.004
Project givens/assumptions clarified	4.40	0.681	10.209	9.200	0.000
Duration of each phase	3.35	1.137	7.773	1.377	0.185
Fulfillment with the techniques from each step	4.10	1.119	9.513	4.395	0.000
Primary function identified	3.95	0.999	9.165	4.254	0.000
Number of ideas generated	3.25	1.209	7.541	0.925	0.367
Equal contribution of participants	3.15	1.137	7.309	0.590	0.562
Efficiency of idea generation (Using BIM application)	4.15	0.813	9.629	6.328	0.000

According to the previous table, it can be concluded that:

The responses of the sample show Moderate important towards the dimensions “workshop factors”, where mean is 3.92 while its standard deviation is 0.934 and that means the responses is Concentrated on its mean, so the trend of the sample responses towards the dimensions is “agree”. Regarding to T test we can say that most of the statements have significant difference than 3, which mean that there are difference trends of the sample towards these statements.

The descriptive Statistics, mean Std. deviation, t test for Post-workshop factors.

Table (3) the descriptive Statistics, mean Std. deviation for Post-workshop factors.

item	Mean	Std. Deviation	Relative weight (%)	t test	sig
Percentage of the Action Plan carried out without confusion	3.65	0.988	13.619	2.942	0.008
Quality of the report and present if there any clash between activities after applying new ideas (Using BIM)	3.95	0.945	14.739	4.498	0.000
Accelerating the decision-making	4.45	0.686	16.604	9.448	0.000
Client's satisfaction	4.45	0.686	16.604	9.448	0.000
Identifying and clarifying the client's requirements	4.45	0.605	16.604	10.722	0.000
Going to improve coordination and communication between stakeholders	3.40	1.095	12.687	1.633	0.119
Enhancing quality of the project	2.45	1.099	9.142	-2.238	0.037

According to the previous table, it can be concluded that:

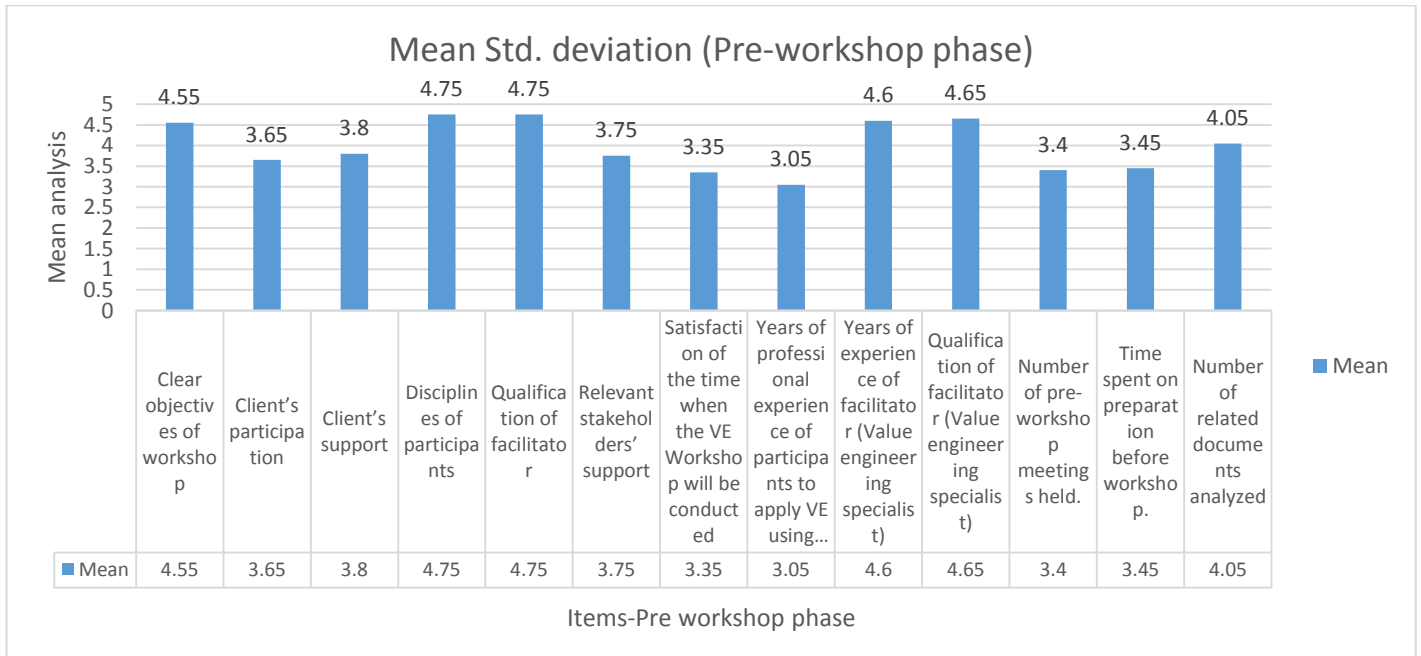
The responses of the sample show Moderate important towards the dimensions “post workshop factors”, where mean is 3.83 while its standard deviation is 0.872 and that means the responses is Concentrated on its mean, so the trend of the sample responses towards the dimensions is “agree”. Regarding to T test we can say that most of the statements have significant difference than 3, which mean that there are difference trends of the sample towards these statements.

Results analysis for the Questionnaire:

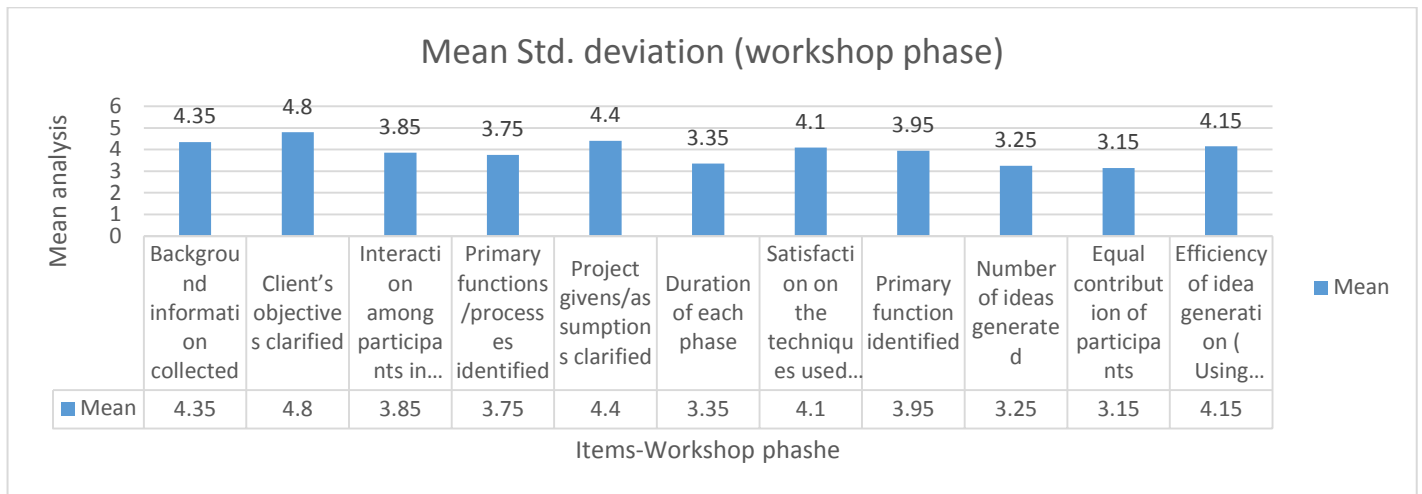
After analyzing the descriptive Statistics mean Standard deviation and according to statistics experts we can classify the importance of each item using the following margins:

- **(4.20-5.00)** Extremely important , **(3.40-4.20)** Important , **(2.60-3.40)** Moderate of importance , **(1.80-2.60)** Not important , **(1.00 -1.80)** Extremely Not important

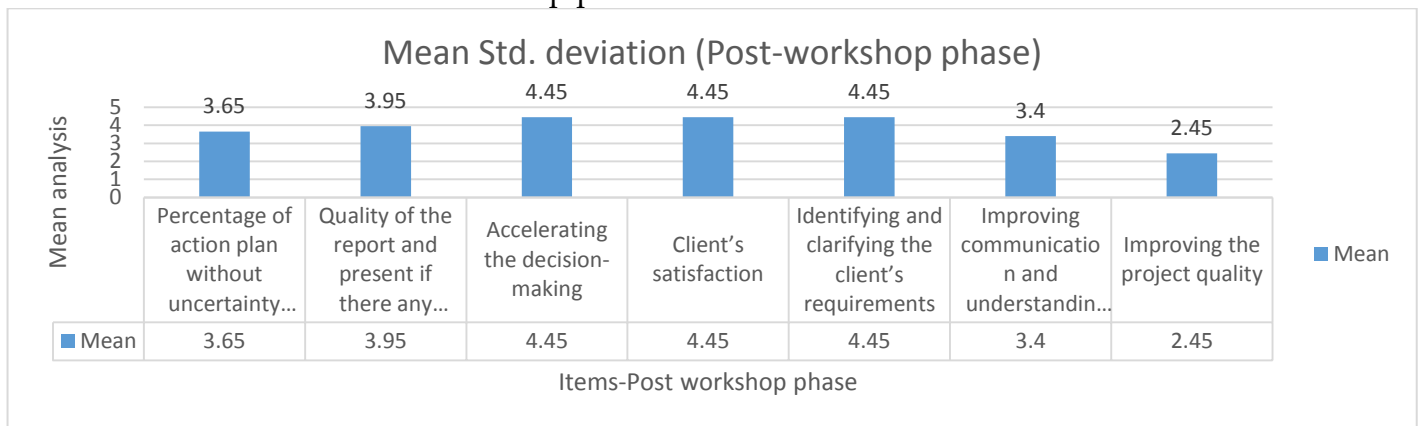
So, after analyzing the collected questionnaire answers at Pre-workshop phase:



The data at workshop phase:



And the data at Post workshop phase:



Conclusions of the research objectives, questions, and hypotheses

In order to achieve the objective of the study, many objectives are outlined and achieved through the findings of the examined questionnaires and thus through the workshop, those objectives are linked to research questions that have been formulated in order to increase one's understanding and knowledge of the subject, and the results have been described as follows:

Outcomes related to objective one

The objective was: To examine and analyze the significance of Value Engineering application in the geopolitical area for improvement of construction project management.

The first research question: what is the level of knowledge of VE implementation for Mega project professionals, particularly underground and tunnelling projects?

The research found that the effect of awareness-raising value engineering within the nation is quite low, as 60% of the sample-who considered VE experts within the framework of Mega projects did not apply VE methodology.

Outcomes related to objective two

The objective was: to research the factors influencing Value Engineering studies and apply them to the proposed framework.

The second research question: What are the important factor which influence on Value Engineering Studies within the construction industry firms in Mega projects especially underground and tunneling projects?

The study discovered that the following ten factors are the foremost important factors that influencing VE Studies:

- I. Qualification of facilitator
- II. Background information collected
- III. Quality of the report
- IV. Percentage of action plan without uncertainty distributed
- V. Client's objectives clarified
- VI. Clear objectives of the workshop
- VII. Client's participation
- VIII. Disciplines of participants
- IX. Client's support
- X. Qualification of facilitator
- XI. Interaction among participants in each phase

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