Investigation of Road Construction and Analysis of Cost through VE

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Abstract: **The Current building practices requires a great effort to balance factors such as Money, time and quality. Compared to others Industries looked like the construction industry Still difficult to deal with. It has been proven That some modern techniques can be easily Adapt to the project to balance the above factors. This research investigate the Value Engineering is an effective tool to encourage the quality of construction. The goal of low cost and high services the value Engineering is the methodology used to analyse Function of goods, services and access Jobs are required of good and service User at the lowest total cost without limitation Quality performance required. It's intense, multi-disciplinary problem-solving activity It focuses on improving the value of jobs that Are required to achieve the goal, or goal of Any product, process, service or organization. in a in this work, we discussed the concept of value. Value Engineering can play a key role in ensuring that programs stay within budget or even save money. Value engineering, being a very creative and effective approach, must be appreciated and understood at all level of the project management and must be accepted worldwide.**

Keywords: **Road Construction, project management, Value Engineering, construction sector**

I. INTRODUCTION

Value Engineering **(Ibusuki, 2007; Cooper, 2017)** identifies the function of a product or service, builds the value of that function, and ensures that the required function is provided at the lowest life-cycle cost, a recognized technology It is a systematic application. On the highway side, products and services include not only the structural elements of the highway, but also the processes, equipment and consumables used in the development process from concept to operations and maintenance. In all cases, the required functionality should be achieved at the lowest life-cycle cost and meet the performance, maintainability, safety and aesthetic requirements. Complete the project and assign costs within the specified time period. We deliver value to our customers by providing outstanding customer support. Roads are an integral part of the transport **(Van *et al.,* 2016)** system. A country's mad network **(Yu *et al.,* 2016)** should be efficient in order to maximize economic and social benefits. They play an important role in achieving national development and promoting the overall performance and social functioning of the community. People are aware that roads can improve mobility. Let people get rid of isolation and get rid of poverty. In China for instance, the government has popularized this belief by emphasizing that for any economy to develop, transport **(Van *et al.,* 2016)** must start off first which will later stimulate other sectors to develop in an orderly fashion.

The most important factor that developing countries need is economics. Politics and the military play an important role in each part, but without proper communication and traffic, they cannot achieve a good job. There are three main means of transportation. They are two major land transports, land and land. They are a train and a car, but both require roads. Cars can travel without roads, but they are difficult and dangerous. The train cannot be moved by train. Traveling in tropical countries such as Myanmar is very difficult without roads, even if it is raining. There is dirt here and there, they always cause car and train troubles. Therefore, our government is building roads and railways throughout the country to protect the safety of our citizens. The foundations of the economy are trade and human trade. It needs to be transported. The national economy will develop as people travel and do business in different places. When political ants travel the country to meet the people, they also need a way. They will need a way to get there as soon as possible when officials are ordered to check the area to ensure the safety of the citizens. In this way, people can stay in their home safe and sound and so people.

Road Construction

Road construction in India is about 15 billion. The contracting industry includes large-scale contractors (more than 5 million rupees), and about 20 companies occupy 40% of the construction industry **(Eastman, 2018)**. Medium-sized contractors (150 to 500 million rupees) account for about 20% of construction activity, and small-scale contractors (500 million to 100 million rupees) account for the remaining 40%.

Construction Material
- Embankment
- Semi-paving structure basic course
- Special material for surface treatment drainage
- Maintenance

Road Construction Equipment
Early labor-based methods were mechanized and introduced in the 1960s. It is a government. The agency is a major buyer of road construction **(Eastman, 2018)** equipment, and the market is undergoing transformation, limited in the 1980s. The project grows- External Funding need to use appropriate equipment prequalification criteria. Based on the contractor's choice of equipment ownership. With a large project, 10% of the prepayment was done, and the contractor started buying their own equipment.

Application of Value Engineering in Construction

VE (value engineering) was developed at General Electric Corp. during World War II and is widely used in industry and government, particularly in areas such as defence, transportation, construction and healthcare. VE is an effective technique for reducing costs, increasing productivity and improving quality. It can be applied to hardware and software; development, production and manufacturing; specifications, standards, contract requirements and other acquisition program documentation; and facilities design and construction. VE is defined as "an analysis of the functions of a program, project, system, product, item of equipment, building, facility, service or supply of an executive agency, performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety and life cycle costs". It may be successfully introduced at any point in the life-cycle of products, systems, or procedures. VE (value engineering) was developed at General Electric Corp. during World War II and is widely used in industry and government, particularly in areas such as defense, transportation, construction and healthcare. VE is an effective technique for reducing costs, increasing productivity and improving quality. It can be applied to hardware and software; development, production and manufacturing; specifications, standards, contract requirements and other acquisition program documentation; and facilities design and construction. VE is defined as "an analysis of the functions of a program, project, system, product, item of equipment, building, facility, service or supply of an executive agency, performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety and life cycle costs". It may be successfully introduced at any point in the life-cycle of products, systems, or procedures.

Value Engineering and Application

Application of Value Engineering Methodology for Roads and Highways Project January 2011, Muhammad Ajmal Khan, Senior Engineer, Roads Department Design Division.

VE / VA / VM A systematic approach to improving the "value" of a product or service using functional checks. V (value) = F (function) / C (cost) VE uses a combination of creative and analytical techniques to determine alternative ways to achieve the goal. The use of functional analysis distinguishes VE from other problem-solving methods. While VE does not compromise basic functionality, it also reduces costs and adds functionality. "Basic Features" refers to the features that a user needs for a product or service. For any civil engineering project: VE uses creative thinking to achieve the project's original purpose (basic functions) with minimal life cycle cost, without sacrificing safety, required quality and environment The application of attribute value engineering is mainly as follows. -Problem Solving-Cost Reduction-Improvement of value, quality and performance-More efficient use of resources-Reduction of time value of project completion, value analysis/ value mythology.

Value Engineering: In Design Review, there are no plans to skip a design, or review a designer's drawings, BOQs, quotes, etc. Cost reduction processes cannot cut costs at the expense of required quality, reliability, or performance. Completed regularly by all design engineers is not part of the regular design process, but is a formal cost and function analysis.

What Value Engineering Can Do: Focus on the "big picture" to improve decision making. Develop a realistic budget to ensure that the required functional scope extends the understanding of the entire project. As the design process is accelerated, interdisciplinary communication is promoted and unnecessary cost.

Value Engineering Process: How does the value method work? The value approach works through VE / VA / VM research. It brings together multidisciplinary teams with knowledge and expertise to identify and solve problems. The VM research team works under the guidance of a counsellor, reviews the project according to a series of established procedures-virtual machine work planning-the team understands the customer needs and develops a cost-effective solution I will be able to. SAVE International Information stage creation phase functional analysis phase evaluation phase development phase demo phase project scope to identify other ways to execute the function scope of project, TOR, policies, design criteria, standards, specifications etc. Start-ups, requirements, existing conditional budget VE teams have created selected alternatives / suggests with sufficient documentation so that decision makers can decide whether they can make the right decision. Introduce alternative team leaders to develop reports and presentations, and document VM / VE / VA work plans of VE process → team leader + multidisciplinary team + VE work plan implementation and monitoring phase.

When a Value Engineering Study should be undertaken: Savings and Value Costs Building Engineering Time Final Design Preliminary Design Concepts Constructive VE Opportunistic Intervention the cost of changing a project depends on when VE is introduced. Initial changes are, of course, realistic and more cost effective than later, as shown in the following figure.

Primarily policy makers and designers are responsible for managing the life cycle costs of project value projects, and they are responsible for managing costs.

Value Engineering: Muhammad Ajma Khan was applied to road and highway projects at the project launch and design stages By Muhammad Ajma Khan Senior Engineer Roads Planning and Design Section Roads Department January 2011.

Green Book (AASHTO) Guide to Flexibility in Expressway Design (AASHTO, 2004) this book combines design standards with the flexibility of highway design to achieve design flexibility.

Value Engineering: Important information through design flexibility-many designers with inflexibility and flexibility to save experiences.
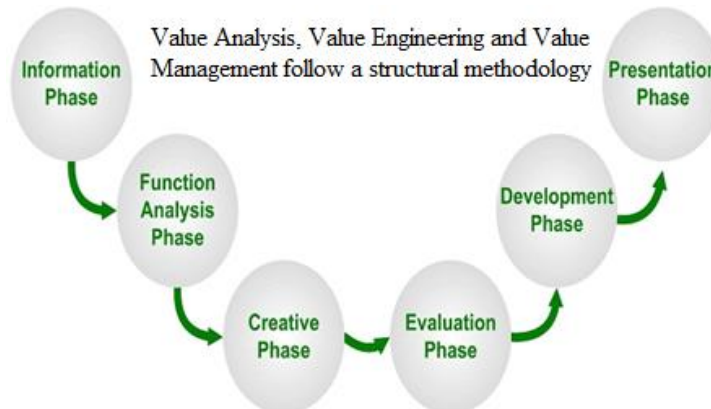

Fig. 1: Value engineering and application

II.   METHODOLOGY

The value approach is a systematic process that follows a work plan. There are several stages to work planning. The recommended VE method (work plan) that the VE team uses during the workshop has five different phases. In short, the following will be described step by step.

A. Information Phase: The VE team gets as much information as possible about project design, background, constraints, and projected costs. The team performs functional analysis and relative cost ranking of systems and subsystems to identify potential high-cost areas. The information phase also includes the creation of cost and energy models from cost data aggregated before the start of the workshop.

B. Function and Creative Phase: The VE team uses creative group interaction processes to identify alternatives for implementing system or subsystem functionality. Functional analysis stimulates a fierce debate and forces a more extensive and more comprehensive understanding of the project by forcing the team to aspects that they would not normally think of.

C. Evaluation/Analytical Phase: The ideas generated in the speculation / creation phase are screened and evaluated by the team. Choose the ideas that have the potential for maximum cost savings and project improvement for further study. The VE team evaluates ideas in the creative phase of development. The VE team ranks these ideas. Ideas that do not appear to be irrelevant or worthy of further study are ignored, and ideas that represent the greatest cost savings and potential improvements are selected for development.

D. Development/Recommendation Phase: The VE team selected ideas, created explanations, sketches and life cycle cost estimates to support the proposal as a formal VE proposal. At the development stage of VE research, each specified idea was expanded into a viable solution. Development includes recommended design, comparison of capital and lifecycle costs, and a descriptive assessment of the strengths and weaknesses of the recommendations.

E. Report Phase: The VE consultant works with AE and the representative to present the results of the VE workshop and create a VE report designed to achieve the objectives of the VE program. The post-study part of VE research included the finalization of VE reports to incorporate VE proposals developed during the workshop. Next, the designer responds by accepting the proposal and including it in the project design, rejecting the proposal, or proposing a further survey.

III.   DATA ANALYSIS METHODOLOGY

Data analysis This is a process of data checking, cleaning, transformation, and modeling that aims to discover useful information, inform conclusions, and support decisions. Data analysis has multiple aspects and methods covering different technologies with different names and names, and is used in different business, scientific, and social science areas. In today's business, data analytics make decision making more scientific and plays an important role in helping companies perform effective tasks.

Data mining is a specialized data analysis technology that focuses on modelling and knowledge discovery for forecasting, not purely descriptive purposes Data analysis covered by business intelligence focuses primarily on business information Depends on the aggregation. In statistical applications, data analysis can be classified into descriptive statistics, exploratory data analysis (EDA) and confirmatory data analysis (CDA). EDA focuses on discovering new features in the data, and the CDA focuses on identifying or forging existing assumptions. Predictive analysis focuses on the application of statistical models for predictive prediction or

classification, but text analysis uses statistical, linguistic, and structural methods to obtain information from text sources (unstructured data) Extract and classify. All of the above are various data analysis.

Regression

Linear regression is a basic and commonly used type of predictive analysis. The general idea of regression is to test two things: (1) is the series of predictors working well in the prediction of (dependent) variables? (2) Which variables, particularly important predictors of outcome variables, and how do they represent the magnitude and sign of the beta estimate-outcome variables? These regression estimates are used to explain the relationship between the dependent variable and one or more independent variables. The simplest form of a regression equation with dependent and independent variables is defined by the equation $y = c + b * x$. Where y = estimated dependent variable score, c = constant, b = regression coefficient, x = score independent variable

Chi-square (R2)

The **Chi-squared** statistics are often used to test the relationships between categorical variables. The null hypothesis of the chi-square test is that there is no relationship between categorical variables in the population, and they are independent.

The Chi-squared statistics are most commonly used to evaluate independent tests when using cross tabulation (also called bivariate tables). The cross list represents the distribution of two categorical variables whose intersection of variable categories is displayed in the cells of the table. In the independence test, when variables are independent of each other, reaction patterns observed in the cell are compared with expected patterns to evaluate whether there is a relationship between the two variables. By calculating chi-square statistics and comparing it to a chi-square distribution threshold, researchers can assess whether the number of cells observed is significantly different from the expected number of cells. Calculation of chi-square statistics is very simple and intuitive. Here, fo = observation frequency (number of observation cells). If there is no relationship between variables, fe = expected frequency. As shown in the equation, chi-square statistics are based on the difference between the data actually observed in the data and the data that is not actually relevant among the variables.

IV.   MATERIALS AND METHODS

Time cost and quality: The time, cost, quality triangle is commonly used in Value Management workshops as a Tool to elicit from the client their value criteria. The Facilitator commonly asks for team Consensus on the position of the dot that indicates the team's relative value criteria in Terms of the three variables, time, cost and quality. Invariably this discussion commences with client stating all are important and therefore, the dot should be in the centre. It is only after protracted discussion that the position of the dot tends to move. Figure below illustrates a time cost quality triangle for a proposed new court project The dot indicates the result of a discussion in which the team agreed that quality is more important than cost and that Time is not important in the context of a replacement for an existing court. In this study, it is proposed to take three variables of cost, time and quality and discuss them in relation to VE with the intention of decide a method of measuring the client's value system.

Data Analysis: Data for this study were collected by Mathura (NH-2) on a highway constructed in Delhi, and the country of India is headed with "5" different projects from January 2019 2019. Numbered kilometres (KM). Basic total project costs are selected in Lakhs (L) and Time Day (D). The survey also includes value engineering (VE) and consultants, employers and contractors about their quality. All this data is stored and analysed using the software adv. In Excel. The main purpose of analysing data using "Adv. Excel" is to create a result that implements a model value project. After fitting the multiple regression model for engineering as a dependent (response) variable containing time, cost, quality data and a dependent (interpretation) variable, the regression model was significant at 95%, with a probability level of 0.05. Accept the value the multiple R squares of this model are also very important. These variables describe the distribution of which values. The parameters that can be included in the model are a significance level of 95 and a p value of 0.05. Thus, the final model is:

Multiple linear regression method: The analysis results obtained are as follows. Analysis, the main road construction value engineering prediction model is as follows.

VEMRC = F (DepF(T), DepF(C), DepF(Q)); This is done from the line fit plot of the excel result.

Where, Time = T, C = Cost, Q = Quality

R-Square on almost all models is almost the same as adjusting R-Square. In other words, the model is suitable for regression. This study implemented model value engineering in major road construction, which could reduce construction cost and time and improve project quality. However, other variables cannot be included in the model (because their p-values are greater than 0.05).

Conclusion of the chapter to use different types of analysis. The time, cost, quality triangle is commonly used in Value Management workshops as a Tool to elicit from the client their value criteria.

V.   RESULTS AND DISCUSSION

In this paper we examined five different projects from Delhi to Mathura as expressway projects. Surveys collect data in a very limited amount of time, including cost, time, and quality. In this value engineering, everything is optimization, except that in this article we examine each element's dependency (DepF) on the other two elements.

Table 1: Summary Time Output

Summary Output	
Regression Statistics	
Multiple R	0.941345353
R Square	0.886131074
Adjusted R Square	0.877696339
Standard Error	0.738162513
Observations	30

Table 2: P-value of Time Output

	Coefficients	P-value
Intercept	1.718625006	4.39E-05
Quantity	10.65870567	2.57E-09
Cost	-0.173836526	0.029699

DepF(T)
Time = (10.65870567)* Quantity + (-0.173836526) Cost

Table 5. 3 Summary Statistics of Quantity Output

Summary Output	
Regression Statistics	
Multiple R	0.97103
R Square	0.942899
Adjusted R Square	0.938669
Standard Error	0.05946
Observations	30

Table 3: P-Value for Quantity Output

	Coefficients	*P-value*
Intercept	-0.06887	0.071159
Cost	0.0264	1.58E-06
Time	0.06916	2.57E-09

DepF(Q)
Quantity = (0.0264)* Cost + (0.06916) Time
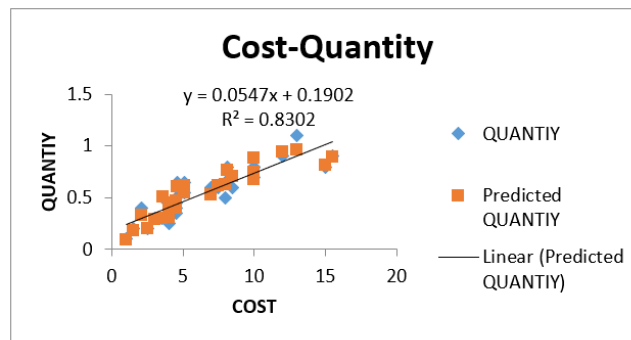
Fig. 2: Line fit plot for Cost
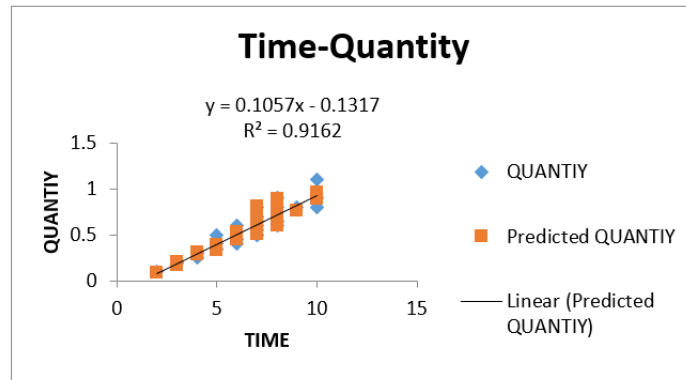
Fig. 3: Line fit plot for Time

Table 4: Summary of Cost Output

Summary Output	
Regression Statistics	
Multiple R	0.904561
R Square	0.81823
Adjusted R Square	0.804766
Standard Error	1.715915
Observations	30

Table 5: P-Plot for Cost Output

	Coefficients	P-value
Intercept	0.516329	0.648682
Quantity	21.98568	1.58E-06
Time	-0.93935	0.029699

DepF(C)
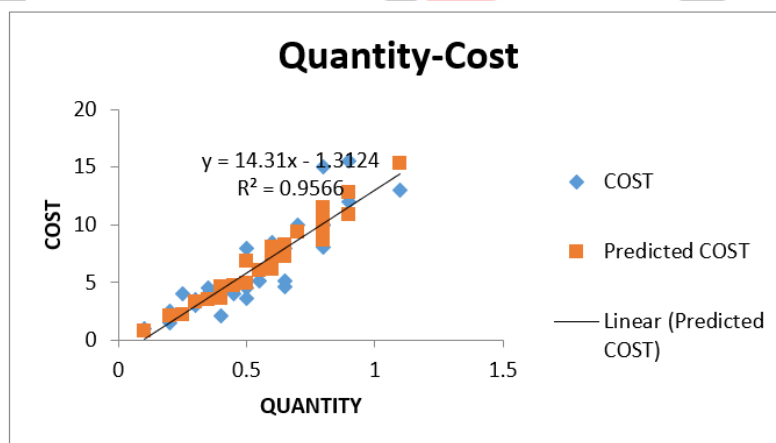**Cost = (21.98568)* Quantity + (-0.93935) Time**
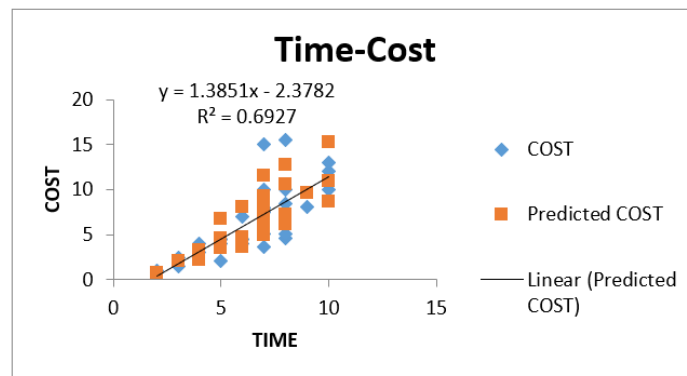

Fig. 4: Line fit plot for Cost Output

Fig. 5: Line fit plot for Cost Output

Conclusion of the chapter in this value engineering, everything is optimization, except that in this article we examine each element's dependency (DepF) on the other two elements

CONCLUSION AND FUTURE SCOPE

The model of this study can be used to evaluate the outcome of the project in VE research. In this model, the technology VE used by each KM is implemented by reducing costs, reducing time and improving quality. Therefore, this model could be used to test another project and be used for other projects in this study separately calculated and displayed the linearity between VE and cost, time, quality. In order to evaluate the effects of VE research, it is necessary to consider not only the final economy but also the interrelationship between VB and time, the relation between VB and quality, and the reciprocation between accelerator and project participants. However, VE, others road construction projects are reviewed and opportunities for better, less expensive means of completing the projects are analysed. The aim is to improve the quality and productivity of the project, to promote innovation, to optimize the design factors and to secure the overall economic cost. The goal of VB's research is to achieve excellence. The goals are to improve quality, minimize total cost of ownership, and reduce construction time.

A VE program provides the highway administrator with a means of controlling life-cycle costs without sacrificing project quality or arbitrarily reducing its scope, but it will not happen without the involvement and cooperation of all levels of highway management. Value engineering is not a criticism of the designer. It is an extension of the design process which builds upon and refines the work already accomplished.

Success of a project, deciding on where and how a project will be built, completion of the structure according to desired design and building quality, within determined time and cost limits, are all possible with good estimations and solutions. Realism of estimations is completely in direct proportion to success. Carrying out correct estimations is closely based on the knowledge level of the team. Value engineer assumes regulating and analysing duties to increase the value of the project while preventing unnecessary costs. It is not possible to apply VE on each project a company produces. Much more successful value engineering studies can be carried out on complex and big projects which have high potential of restoring the investment. Of course, value engineering works have a cost, therefore this project shall be big enough to meet this cost and obtain profit. The purpose of value engineering is not just reducing the costs, increasing the design standards, making it easier to build the project and saving time and money. VE must create a balance between all the needs of the project.

Purpose of VE shall be determined in direction of company purposes. Every person that joins for VE shall be embraced. There should be no one in the team who thinks in the opposite of project management, or who is suspicious in the benefits of VE. The highest performance in VE is achieved especially when the purpose is mainly increasing the value rather than reducing the costs. Production methods developed with VE are carried out to reduce the costs of a product without sacrificing the quality, keeping the cost fixed by increasing the quality or shortening the production time. It shall be never forgotten that VE works are not just the savings of contractor but also savings that are made in the project in direction of the contractor's and the customer's interests. Contractor's own saving is a kind of economical saving. When the projects in the world are taken into account for which VE is used; we can see that most of them are applied on civil engineering constructions. Because analyses show that contribution of potential savings from VE applications is much greater at earlier stages of a project. When VE applications are regularly carried out in Turkish construction sector, it will be seen that the competition between the companies will increase and prices will become lower. More importantly, systematic working and the quality will increase in addition to them. This thesis finds Time cost and quality data shows and Analysis, the main road construction value engineering prediction model. There is table define Summary Time Output data and P-Plot for Cost Output.

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