A Method of Cost Optimization By Using Value Engineering: A Review Paper

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Abstract- *Value Engineering is a precise interdisciplinary method that mends the relationship between cost and caliber of their function. It is a creative effort achieved by many construction companies focus on accomplishing maximum value with regard to assuring a good quality product along with a useful life.*

Value engineering is not just an engineering initiative to solve the organizational challenges. The success of a construction project turns into a massive failure in case of scarcity of skilled workers, imbalance in safety instructions on workplace and undefined flexibility in work manship compensation cost, transformation of labor laws, high employee turnover due to flat wages and working environment. Furthermore, as the globalization increases besides variations in different field involving Economy,at that time Technology upshots in change of behaviorof Economy that starts behaving in a strong way when demand is raised, people spend more, results in increase business revenue and vice-versa. The study ends with the conclusion stressing on the need of few techniques to enhance the productivity and overall life cycle cost so that value of product to the customer is improved.

Keywords- Value engineering, Company, Engineering.

I. INTRODUCTION

Value engineering deals with the customer's primacy, efficiency, desire &demand, if they are amenable to pay for good performance then value of product can be increased. Value engineering is a tool to improve the quality of goods. It aimed at improving the value of a product and optimizes the cost, enhances the performance, utility and operation.Every design should have a good quality, appearance, useful life and a good functional performance. In other words, all of these items should be optimized in order to reach the satisfactory value that we expect from a design. If any of these factors have been reduced or increase in order to save cost, then this process is named as Value Engineering.[1]

$$VALUE^{max} = \frac{PERFORMANCE^{max}}{COST^{min}}$$

1.1 COMPONENTS OF VALUE ENGINEERING

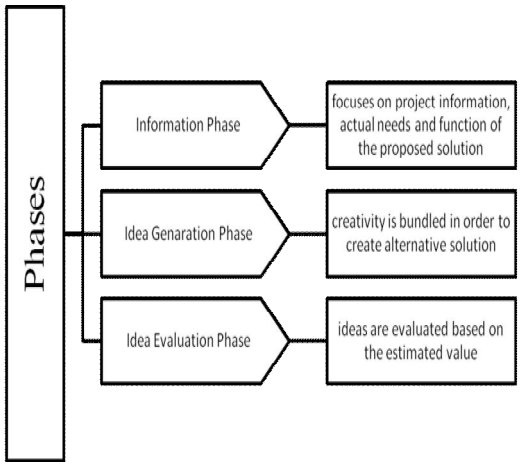

Figure 1.1 Stages *of VE*

Cost optimizing and project enhancement are the two main areas which are tremendously served by value engineering. Value engineering is used as a feasible substitute when there is shortage of experienced labor,raw material is seldom and items are not readily accessible.

1.2 SCOPE OF VE

The overall scope of the project work is divided into components, considering each and every individual component for alternatives which can be used in the benefit of materials and equipment's selection, engineering layout, maintenance & construction operations. Here, Value engineering is adapted at various stages of the project to fulfill the primary objective of cost optimization. For Ex: value engineering is required in the case when a new project, product or a service has been implemented. Identifying the parameters affecting performance, the overall project life

cycle &budgeting expectations that makes the delay in project affecting the quality and productivity of the project. The study will be conducted at various stages of outgoing project. In spite of using value engineering some of the companies finalize their projects design and implementing it on later stage makes it costlier. A live example of application of value engineering is utilized in one of the "Gold Mine project" in "South Africa" where value methodology was applied to optimize the operational cost without affecting the sustainability and performance of project. The proper involvement of management is required to make sure where the money is getting wasted and where the inadequacies are.It is suggested that VE study should be performed in the design as soon as possible which makes it more adequate, effective, and has better result on productivity and quality.

1.3 Background of Study

The study of VE was devised at **General Electric Company** during the time of World War II in search of best alternative to materials and resources that were unavailable or only present at aerated costs. It began during World War II due to the war there were shortage of experienced labors, basic materials and component parts. **Lawrence D. Miles,Jerry Leftow, Harry Erlicher** looked for a substitute and identified that it often reduce cost, enhance the product and its quality. They started this process with a systematic technique and call it as value analysis which sometime start with the project management or industrial engineering discipline as a technique in which value of a system is being optimized by drafting a mix of function, performance & cost. In most of the cases this practice identifies and remove the irrelevant expenditure thereby increasing the value to the producer and to their clients. It seeks for a structural process exclusively lean on function which is suitable to both growth oriented and cost cutting initiative.[2]

1.4 Value Engineering Methodology

Figure 1.4*Working of VE Process*

1.5 Case Study based on Statue of Unity

"Statue of Unity", a tribute to 'Sardar Vallabh Bhai Patel', has been recorded as the tallest structure in the entire construction industry that is quickest to be finished within a duration of 33 months. Larsen and Toubro had created a world record of constructing an iconic structure as compared with world's renowned "statue of Spring Temple Buddha" which is the second tallest statue, situated in china.[3]

Initially three models were designed measuring 3 feet, 18 feet and 30 feet for the construction procedure. Sardar Vallabh Bhai Patel's dhoti dressed legs & footwear's were making the design thinner as compared to the top of the structure thus affecting the stability and safety of structure tackled by upholding a slenderness ratio of 16:19.The farmers were in between asked to donate their farming appliances to collect the iron needed for statue from which 109 tonnes of iron was used to construct foundation of the statue. A total of 21,000 cubic meters of cement concrete,18,500tonnes of reinforced steel, and 6,500 tonnes of structural steel were utilized in the construction. The front part is covered with 1,850 tonnes of bronze layer, 1,700 tonnes of bronze plates.
The overall project was funded by Government of Gujarat which will encourage tourism, which brings Sustainable Development. The United Nation states that increase of environmental outcome and promotion of native culture is only possible by sustainable development. This project had confronted a lot of environmental and benevolent disputes. A group of protestors had raised a problem on Union Ministry of Environment & Forest (MOEF), stating the construction need to be stopped and needs environmental permission under the Environmental Impact Assessment (EIA) which will have a major impact on ecosystem, atmosphere, structure stability and safety issues. Land was acquired forcibly from local adivasi's for development of tourism infrastructure despite their opposition. Cash compensation was given with the commitment of money for land and thousands of people got the employment opportunity directly or indirectly mainly in nearby areas of Narmada district who were totally dependent on their land for earnings. Approximately ten lakh tourists were estimated who will visit statue of unity per year. It is going to create massive revenue from tourism and is expected to recover the total amount spent on structure within 35-40 years.

Table 1.5 Specifications

Parameters	Statue of SVP	Statue of Buddha
Height(meters)	182 (597 feet)	128 (420 feet)
Overall Cost(Rs.)	2979 Crores	395 Crores
Year of Completion	2018	2008
Rise in Inflation Price from 2008-2018 17.46%		

According to the past data, the inflation prices are examined to be increased in the duration of 10 years. An ambiguity arises here that if the inflation prices are increasing by such a less percentage then how the cost has increased thousand times. There must be a reason of not following the

process of value engineering behind this huge difference, which could have been resulted in compressed cost.[4]

1.6 OBJECTIVES OF RESEARCH

The aim of this study is to establish the finest alternative to fulfil the customer's requirement so as to acquire the most durable and efficient service.

- To attain more productivity of projects along with optimality.
- To produce the best quality product along with minimizing the risk factors.
- To identify and figure out the need of cost analysis.
- To eliminate,organize and allocate idle resources to get optimum result.
- To cop up with the cutting edge technique to maintain environment hygiene.

II. RELATED STUDIES ABOUT THE TOPIC

- K.A.A.Ahmed & R.K.Pandey (2016),clarified the theory of Value Management in construction sector.The U.S.A,the Japan,the Europe are the three markets worldwide who identified the concept of value engineering.In order to attain highest number of substitutes to obtain the required function,a job plan was prepared.Pre study,value and post study are the bullet points that illustrate the work progress from initial to final stage of work.The study has come up with the result of non-awareness of value engineering and similar terms among the people.[5]
- C. M. Annappa & K. S. Panditra (2012),discussed about value engineering methodology that changed materials and components design, a study of universal testing machine. Observation was increase in unnecessary cost because of use of costly material,increase of stocks and so on. Technique of value engineering was applied to minimize the effect of cost of UTM components.The case study suggested the use of less expensive materials for the reduction of cost. Four separate costs were found for various types of components included present cost,modified cost,net saving and cost reduction. Value engineering results in reduction of cost by using alternate light and less expensive material.Here, the study was conducted on five components that results 20.84% of net saving cost.[6]
- U. A. Mahadik (2015),states that one of the way of minimizing cost of construction is sustainable analysis and value engineering.Time and Cost are the two main aspects of any industry which highlight the value of cost reduction technique.A job plan is also prepared here,the purpose of job plan is to identify &focus project functions,so as to generate new ideas that results in value enrichment. The Value engineering job plan comprise of 5 phases: Information Phase,Creative Phase, Evaluation Phase, Development Phase, and Presentation Phase.It ends with the conclusion that value & economy both are improved by the application of alternative design and construction methods without sacrificing the quality.[7]
- Prof. N. L. Rane (2016),utilized new techniques in the field of production.In this study value engineering was applied and explained in the sector of construction,by covering Bregana-Zagreb-Dubrovnik Motorway construction in Croatia by BECHTEL – ENKA joint venture as sample project. Study declared that near about $43,000,000 &12 months of time were saved just because of value engineering works that contributed financial saving of 6% and work time reduction of 17%.[8]
- R. Atkinson (1999), proposed a research depicted the success measures of project management. "Why Projects fail"is the highlighting factor of carrying out this study. The main purpose that contributes to the failure of projects is lack of proper management, knowledge, skills, tools & the most important Methodology. The **IRON TRIANGLE**includes cost, time and quality is utilized to measure the success and recommending the new way to consider the success norms, called **Square Route** for understanding the success criteria of project management. Two types of errors were found which exist behind the failure of project. Type-I error when something is incorrect and Type-II error when something is missing. To avoid these type of errors from the overall project Atkinson suggested that the Iron Triangle can be established to develop the Square Route of Success of Project Management to transform the vision into reality.[9]
- V. Grover &M.K. Malhotra (2003), synopsized the transaction cost outline in operations management and supply chain management. In this article, a model of cost is afterwards presented by collecting the data from approximately 203 engineering firms that is to acquire the prevailing experimental work in management and total cost structure from initial to final stage of work. Coordination costs plus Transactions riskconsidered to be the two major components of Transaction Costs. Previous studies done by various authors have been covered in this paper including samples, key dependent & independent variables and their key findings to get the optimistic relationship between product difficulty and integration.[10]
- N. P. Archer & F. Ghasemzadeh (1999), simplifies the selection process of project portfolio by creating a work structure from initial to final stage which disperse the work into distinct phases. Each phase has a specific

objective that contributes to the next stage. There are various techniques available for optimization and project handling, still a lot of construction projects are not able to attain their time & cost objectives. A prototype is labelled that boosts the decision making activities to execute the framework in the form of decision support practice.[11]

- J. Pollack (2007), looked at the information associated with hard and soft prototype on project management. The significance of this paper to is understand how both the paradigms have been manipulated and are progressing to manipulate, the field. The theoretical source of project management is primarily imbedded and the discussion of theoretical source of project management is infrequent. In any case if progress is there in the field then it is important to understand the theoretical source first since it provides aprospect to understand the hypothesis moreover, gives an alternative, when it is suitable.[12]
- J. Chabbra & B. Tripathi (2014), discussed in detail about the modern ways of cutting costs, improving work excellence, improving profitability, project enhancement, have more customers orientation and satisfaction to their customers. In this viewpoint, the main concerns are value and satisfaction. The study further explains the significance of value engineering in today's scenario and tells why, when & how to apply. The major area of concern is found to be survival, growth & success at work. Furthermore, the foremost priority of work is its value, productivity, time and all of above them is cost, to conquer the best results conclusively. The success stories of various companies like ModiXerox, Mahindra & Mahindra, Kelvinator of India, Escorts, Bajaj, Maruti, Hero Honda, L & T and many more, have also been shared in this paper which are putting efforts in cost improvement & using the concept of value engineering.[13]
- Berawi, M.A, Miraj, P, Gunawan & Husin, A.E, developed a Sunda Strait Bridge connecting two major island in Indonesia using value engineering approach. Value Engineering has been adopted to afford added value and to attain maximum output for project enlargement in terms of enhancement on productivity, quality and technology. To identify the research objective a quantitative approach is adopted including online and offline questionnaire survey. Results concluded from the questionnaire survey conducted to identify the risk affecting the projects performance, identification of other functions for improvement, calculating the investment costs.[14]
- A. Rajguru & P. Mahatme, aimed at identifying the best methods to optimize the cost and difficulties faced by contractors on site at construction stage. The total time taken by project and ever fluctuating environment are the least difficulties faced by contractor at workplace. As various techniques are easily present in the market for cost optimization, still many companies are not able to achieve their objectives. In this paper, Critical Path Method & Program Evaluation and Review Techniques are used by preparing a questionnaire for gathering the information, conducting interviews to strengthen the findings and then finally analyzing the data by Relative indices and frequency analysis techniques. The study was further ended with the conclusion that lack of knowledge, proper management, resources are the main reason behind this problem that needs to be focused.[15]
- R. Stasiak-Betlejewska (2015), studied the applications of value engineering in American transportation industry focused at identifying the lowest possible costs. This paper explores the research findings on the basis of highway improvement projects utilizing the concept of value engineering for economic benefits. Federal-Aid Highway Program (FAHP) is funding each project of National Highway System (NHS) with an estimated overall project cost of approximately $(40-50) million which requires Value Analysis. A study has been conducted on the following states including Virgina, California, North Carolina, Florida, Texas, Minnesota, Georgia, and Illinois by U. S. Department of transportation to execute innovative techniques of Value Engineering. The Information has been collected from Fiscal year 2009-2013 summarize the past VE saving federal-Aid and Federal Land Highway Programs about number of VE studies, Cost of conducting the VE studies, number of approved recommendations, Return on investment & estimated construction cost of projects studied.[16]
- K. Ilayaraja & MD. Z. Eqyaabal (2015), clarified the implication of value engineering in Construction Industry. Today, the construction industry have a major role in nation's economy, and the second main hiring skilled & semiskilled workers after agriculture. This study aimed at recognizing the deprived value of structure and finding out the benefits of study in terms of time, cost, quality, efficiency & better management. It basically works on the analytical descriptive methods which is fully based on real phenomenon. The study is executed in order to acquire a number of performance measures and a survey is prepared on the basis of same.[17]
- L. Ning (2015), focused on design phase of construction project and its cost control applications with utilizing the key procedures of value engineering to eliminate the problems of extended construction period, bad quality and outsized cost. According to Li Ning, using value engineering in the design phase of construction industry has a great significance that counts as the most productive phase considered. In this article, Value Engineering is

using a quantitative approach that demands for lowest possible cost that is creating the project worth. The research design of project focus on the selection of models for project design to attain the functionality of project.[18]

- S. Atabay & N. Galipogullari (2013), described the principles of value engineering, use of rational method and advancement in techniques to acquire the optimum results. Throughout the overall life cycle of project the additional cost control needs to be maintained. By doing the further research a site "Bregana-Zagreb-Dubrovnik Motorway" was taken in Croatia by joint venture BECHTEL-ENKA to check the progress of work after applying value engineering.After applying value engineering, the adequate results were also obtained with the total saving of around 43,000,000$ & 12 months which contributes 6% financial saving and 17% work time reduction to the company.[19]

III. CONCLUSION

This study is using comparative descriptive analysis that primarily concerning on reducing longer duration projects and secondarily focusing on optimizing the raised cost of project, it is considered that operational management techniques are applicable & better to work with, which will definitely create a credit to the project throughout its lifecycle. Project management includes intricate decision making that involves methodologies and knowledge to create sound decisions.The study would be concluded with the finding of optimum cost with the use of operation management techniques.To achieve the appropriate saving in time and cost,Value Engineering can be considered as the best construction Techniques.

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