Application of Value Engineering in Construction Projects

Prof. Nitin L. Rane1, Prof. P.M. Attarde2

1Professor, Department of Civil Engineering, J.T. Mahajan Polytechnic, Faizpur, Maharashtra, INDIA
2Professor, Department of Civil Engineering, SSGB, COE & T, Bhusawal (NMU), Maharashtra, INDIA

ABSTRACT
Value Engineering is a proven management technique that can make valuable contributions to value enhancement and cost reduction in construction industry. Value Engineering (VE) is not a design/peer review or a cost cutting exercise. VE is a creative, organized effort, which analyzes the requirements of a project for the purpose of achieving the essential functions at the lowest total costs over the life of the project. Through a group investigation, using experienced, multidisciplinary teams, value and economy are improved through the study of alternate design concepts, materials, and methods without compromising the functional and value objectives of the client. Value Engineering is the process of relating the functions, the quality and the costs of the product to the determination of optimum solutions for the project. A cost-effective solution is achieved by an application of VE principle for different components of the structures relating its quality and quantity. This research mainly focuses on new techniques, methods and materials that can be adopted in construction industry, in which, its process time, durability and feasibility of product can be detailed. In this study, how the principles of Value Engineering are applied in construction projects is explained, and by taking case study on commercial building as the sample project, practices of Value Engineering in this project are described.

Keywords— Value Engineering, Job Plan of Value Engineering, Cost, Quality aspects of a project, Value Analysis, Value Management.

I. INTRODUCTION
Value engineering is basically a team effort. It aims at promotion of value awareness and raising the level of professional competence and technological excellence in the organization. Value engineering not only aims at cost reduction but also cost effectiveness which in turn enhances the value and provides competitive advantage. Value engineering techniques can be applied wherever cost is proposed or likely to be incurred in terms of money, skills/expertise, energy or other resources. In other words, this will cover practically every area of human activity and value engineering can be considered applicable to all of them. value engineering is applicable to hardware, building or other construction projects and to soft areas, such as manufacturing processes, administrative and management systems, office procedures, books and forms and computer software costs. In case of once through projects such as civil engineering works for example, buildings, highways, water/air/effluent treatment plants, etc and engineering projects such as product design, greater benefits from the application of Value Engineering can be obtained by application of these techniques at the early design stages. Adequate data collection in such studies is essential together with in depth involvement of the agencies dealing with the finance, design, construction and use of the project. Details of materials, methods used with their costs, are essential as part of the data to be collected during the information phase of the value engineering study. [1]

Value engineering results in the increased use of alternative less expensive material, cheaper design, weight reduction, new methods of manufacturing, indigenization, etc, to give the same or better performance, quality and efficiency at a lower overall cost. In order to produce a product or service to be competitive in the open market, the best value is determined by two considerations, namely, function and cost of product. Value of a product or service can be enhanced either by increasing the function or decreasing the cost or both while maintaining the performance quality and reliability. [2]

II. HISTORICAL BACKGROUND
Value Engineering has been applied by many private industries, and local, state, and federal agencies. VE had its origin during World War II, at General Electric, when innovation was required because of material shortages. Some critical materials were difficult to obtain,
and a great many of substitutions had to be made. Mr. Harry Erlicker, a vice president, made the observation that many times these changes resulted in lower costs and improved products. This encouraged him to seek an approach to intentionally improve a product's value. He assigned Lawrence D. Miles, a staff engineer, the task of finding a more effective way to improve a product's value. In 1947, Mr. Miles and his team developed a step by step system, called Value Analysis (VA), to analyze a product's cost and function to ferret out unnecessary costs. Miles combined a number of ideas and techniques to develop a successful methodological approach for ensuring value in a product. The concept quickly spread through private industry as the possibilities for large returns from relatively modest investments were recognized. However, it wasn't until 1952 that VA began its growth throughout industry. In 1954, the U.S Navy Bureau of Ships used the Value Analysis process to cost improvement during design. They called it "Value Engineering" The Value Engineering was used formally in the U.S Department of Defence in 1961. In 1985, the Value Engineering process had gained worldwide acceptance. It spawned an international organization, Society of American Value Engineers International (SAVE Int.), dedicated to its practice, and the certification of competent practitioners. In 1997, SAVE approved a standard for Value Engineering Methodology. [3]

III. LITERATURE REVIEW

1. Neetu B. Yadav, Rakesh Kacha, Neeraj D. Sharma & Hiren A. Rathod states that Application of Value Engineering/Analysis is done by using Job Plan which is an organized and systematic approach. VA job plan is the key of success for a value management exercise. It is through this plan that the already identified areas of value study are subjected to in-depth application to seek new and creative alternatives. The Job plan required the formation of a multidisciplinary team representing a cross section of technical field to conduct the program. [4]

2. Shichao Fan, Qiping Shen, Gongbo Lin defines value management (also known as value engineering in the United States) is a structured and analytical process that seeks to achieve value for money by providing all necessary functions at the lowest cost consistent with required levels of quality and performance. Shichao Fan, Qiping Shen, Gongbo Lin also adopted Group decision support system (GDSS) for identifying the problems. This study presented an experimental comparative study between Interactive Value Management System (IVMS) and the traditional ways of conducting VM workshop for generating new ideas. [5]

3. Urmila A Mahadik states that VE is applied in an organized process known as VE job plan. The purpose of job plan is to assist a study team to identify and focus on key project functions in a systematic manner, in order to create new ideas that will result in value enhancements. [6]

4. Stephen Mansfield, Philip D. Udolnyang, gives comparison of true concept of VE with theoretical and its practical aspect. For reviewing the practical aspects and its application; a detailed survey questionnaire had been sent to various members of construction industry. In this, actually 15% respondents truly participated in a VE study. This study concludes that using VE at the early stage of project (35% of project) will result in additional saving in costs and time. [7]

IV. APPLICABILITY OF VALUE ENGINEERING

Value methodologies can be applied during any stage of a projects, although the greatest benefit and resource savings are typically achieved early in development during the conceptual stages. At this point, the basic information of the project is established, but major design and development resources have not yet been committed. The reason this is the best time to apply a value methodology is because the manner in which the basic function of the project is performed has not been established, and alternative ways may be identified and considered. Examples of these applications are:

Construction projects could benefit by identifying improvements for various project phases: concept development, preliminary design, final design, procurement and construction.

Manufactured products, whether consumer, industrial, or defence, may be studied with a focus on either the design or manufacturing process of that product. A product may be the subject of a value study at any time during the product’s life. A value study can be applied at the onset of the product development to better understand the customer’s needs, identify the functions necessary to satisfy those needs, and develop the initial concept. Throughout the design development, value methodology can be used to refine and enhance the concept, based on the latest facts. Even after a product has been introduced and is in production, a Value Study can be used to further enhance the product and respond to changing customer and economic conditions. A value methodology can be used to either develop new ways to manufacture a product or change an existing process.

Business systems and processes may also be the subject of Value Studies. Many elements of a business or an organization may be improved through the application of a value methodology. This may be from the development of business plans and organizational studies to improving existing business processes.

Value methodologies may be applied more than once during the construction of the project. Early application of a value methodology helps to get the project started in the right direction, and repeated applications help
to refine the project’s direction based on new or changing information. The later a Value Study is conducted in project development, more likely implementation costs will increase. Value methodologies may be used to enhance an organization’s quality programs, new product development activities, manufacturing processes, and architectural and engineering design. [8]

V. VALUE ENGINEERING IN CONSTRUCTION

Construction projects are becoming bigger in size and scope. Construction companies are pressured to deliver construction projects at a lower cost while maintaining performance on design functions. The engineers have always tried to reduce the cost of construction without affecting the quality and the functional utility, however their approach was based mainly on the past experience. Keeping costs low with traditional methods has been a common practice to improve competitiveness. Saving money at the same time, providing better value is a concept that everyone emphasizes. Value engineering (VR) is a practice whose goal is, always, to achieve value for money. With the advancement of science and technology, it became comparatively easy to reduce the construction cost, but the concept of functional utility was not given due consideration. Reliability and durability were of little importance. Only in recent past Engineers and Architects have started taking into consideration these important factors i.e. reliability and durability with functional utility to optimise the cost. This cost of the project is named as functional cost, as the ultimate objective of project planning, construction, management and control is to have its functional utility with durability and reliability at the optimum possible cost. This subject has got emphasize in last few years whose object is to effect economy, in the cost of construction of project. In civil engineering it is related to minimum cost of project or construction work, without affecting the quality. The projects are generally designed by engineers and constructed by contractor. The responsibility of engineer is to design project in a manner such that it must be economical in minimum cost and maximum output. The job of contractor thereafter is to apply his skill to construct the project in estimated cost or if possible even less than that. [1]

VI. METHODOLOGY

The value engineering study uses a systematic procedure called job plan. The job plan outlines specific techniques to effectively analyze a product or service in order to develop the maximum number of alternatives to achieve the products or services required functions. Adherence to the job plan will better assure maximum benefits while offering greater flexibility. [4]

The VE study is consist of five phases: information phase, creative phase, evaluation phase, development phase and recommendation phase. All phases and steps are performed sequentially. [6]

1) Information Phase: The VE team should begin collecting information before the start of the workshop. When supported facts cannot be obtained, the opinions of knowledgeable people can be used. These people can be invited to participate in the workshop, or their opinions can be documented. The Information Phase is typically used to familiarize the team members with the data and the data sources in the context of defining the problem. [3]

Documentation sources includes,

A. Site condition
B. Available resource
C. Requirements resulting from public participation
D. Cost estimates
E. Architectural and Structural drawings.
F. project specifications

2) Creative Phase: The Creative Phase develops ideas for alternative ways to perform each function selected for further study. The objective of the creativity phase is to develop a large quantity of ideas for performing each function selected for study. [9]

This is a creative type of effort, totally unconstrained by habit, tradition, negative attitudes, assumed restrictions, and specific criteria. No judgement or discussion occurs during this activity. Several techniques are available to the Value Engineer for use during the Creative Phase. Brainstorming is a technique popularly used in this phase [3]

3) Evaluation Phase:
In this stage all the alternatives are assessed by evaluating how well they meet the required functions and how great the cost savings will be. The VE team evaluates the ideas developed during the creative phase. In evaluation phase ideas that are not feasible, too hard, not promising, or do not perform the basic function should be eliminated; those ideas that represent the greatest potential for cost savings and improvements are selected for development are selected for the further development. [4]

4) Development Phase: The team prepares alternative designs with cost comparisons of original designs and proposed alternatives. All recommendations are supplemented with written descriptions, sketches, basic design concepts, technical information and cost summaries. The selected ideas are developed into proposals that are clearly written so that the owner and other project stakeholders understand the intent of the proposal and how it benefits the project, and also to identify any potential negative factors associated with the proposal.[4]

5) Presentation Phase:

The objective of the presentation phase is to obtain concurrence and a commitment from the designer, project sponsor and other management to proceed with implementation of the recommendations. This involves an initial oral presentation followed by a complete written report. The written report documents the alternatives proposed with supporting data and confirms the implementation plan accepted by management. Specific organization of the report is unique to each study and organization requirements.[9]

VII. CONCLUSION

Value Engineering is a successful technique that has been tested in many countries and reduces the cost of the construction projects. 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.

VA job plan is the key of success for a value engineering. It is used to seek new and creative alternatives. In this study alternatives used by using Value Engineering results cost reduction without affecting the quality. The highest performance in VE is achieved especially when the purpose is mainly increasing the value rather than reducing the costs. This proves the scope and application of Value Engineering in construction is tremendous.

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