Value Engineering Tool for Sustainability in Construction Projects

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ABSTRACT

Construction projects are done by conventional methods by method of input, process and output. However there is no programmed input to implement value engineering and sustainable analysis within the construction industry. Both value engineering and sustainable development play a very important role regarding quality, reliability, durability and enhancing the performance throughout the life of project without disturbing future needs. Value engineering is creative, systematic effort directed at analyzing functional requirements of a project for the purpose of achieving essential functions at lowest total cost over life span of project. Sustainable development is the balance between economic progress and environmental conservation needed for future survival. This paper reviews value engineering and sustainable construction for achieving best value along with long term sustainability over whole life cycle of project. It also covers different stages of value engineering and correlation with sustainable construction.

Keywords: Value engineering, sustainable construction, sustainable development

1. INTRODUCTION

Recently, value engineering (VE) has gained considerable attention from clients and civil engineers. Now a day's awareness of importance of VE has grown within construction industry. The construction industry has both positive and negative impacts on the environment and people. If the construction industry is to provide the required buildings and infrastructure and at the same time reduce environmental degradation must adopt more sustainable practice and policies. Thus both value engineering and sustainable development play a very important role regarding quality, reliability, durability as well as in enhancing the performance throughout the life of project. During the process of developing a project, different stage of VE and the techniques are beneficial for better planning to achieve sustainable construction.

2. VALUE ENGINEERING

2.1 What is Value Engineering?

Value engineering is a systematic application of recognized techniques which identify the functions of the product or service, establish the worth of those functions, and provide the necessary

functions to meet the required performance at the lowest overall cost. Value engineering concentrates on the effectiveness through stating functions, goals, needs, requirements and desires.

Value (V) = Function (F) /Cost (C)

where V is Value, F is sum of total function performance and C represents cost paid for it. The relation of F and C shows that the lower the cost for optimum function, the better the value.

2.2 History

Value engineering concept was started by Mr. Lawrence D. Miles during 1940's. He worked for General Electric Company (GEC), USA which faced scarcity of strategic material needed to produce their products during world war-II. Mr. Mile was appointed in GEC in purchasing department. At that time there was shortage of steel, copper, bronze and other materials. GEC wanted to expand its production of turbo supercharger for B24 bombers from 50 to 1000 per week. Miles was assigned the task of purchasing material to permit this. Often he was unable to obtain specific material, so he thought to obtain an alternative which can perform the same function. Miles observed that many of substitutes were providing equal and better performance at the lowest cost and from this incident evolved the concept of value engineering.

3. VE STAGES FOR APPLICATIONS

Value engineering can be applied during any stage of a project cycle. VE may be applied more than once during life cycle of construction project. Early application of VE helps in more organized implementation of project activities, thus reducing overall cost by avoiding any major changes right in the beginning. If the application of VE is done in later stages it may result in higher project cost.

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. The VE job plan consists of five phases as below:

3.1 Information Phase

In this phase maximum information is collected from various aspects of project regarding identification of problems to be solved and gathering of information on background, function and requirements of the project. At the beginning of VE study it is important to:

- Understand the background and decisions that have influenced the development of design.
- Define owner's objective and criteria governing the project.

- To analyze issues of project
- To discuss project cost and schedule data
- To prepare cost and energy models

VE team recognizes low quality area and high cost area and sets target quality improvement and cost savings.

3.2 Creative Phase

This phase involves generation of creative ideas and listing of them project viewpoint. VE team provides necessary functions within the project. Large number of ideas are obtained through creative proposals and brainstorming. In team everyone is encouraged to participate. Evaluation of ideas is prohibited in this phase. The VE team is looking for quantity and grouping of ideas, which will be screened in the next phase.

3.3 Evaluation Phase

In this phase of project, VE team together with client defines the criteria for evaluation. It involves:

- Analysis of ideas resulting from creative phase.
- Ranking of ideas by VE team.
- Irrelevant or non-worthy ideas are discarded.
- Selection of ideas which represents greatest potential for cost saving and improvements.

A weighted evaluation is applied in some of the cases to account for impacts other than cost such as quality, safety, reliability, time, constructability, aesthetics, serviceability, durability, maintainability, etc.

3.4 Development Phase

During this phase many of ideas are expanded into workable solutions. It consists of:

- Preparation of alternative designs and life cycle cost comparison of original and proposed designs.
- Description of recommended design change.
- Each recommendation is presented with description, sketches, basic design concepts, technical information and cost summaries.
- Selected ideas are developed into proposals so that owner and other project stakeholders understand the intent of proposal and benefits to the project.

3.5 Presentation Phase

In this phase presentation of recommendation is prepared in the form of a report. The team for presentation consists of client, consultants and other stakeholder representatives. The VE team members describe the recommendations and basis that went during development phase. VE report is shared with client and designers. This begins the evaluation by the client and designer of the VE report. After incorporating client's comments a preliminary proposal implementation action plan is prepared.

4. VE APPLICABILITY

VE can be applied at any stage in a project, even in construction. However, the earlier it is applied the higher the return on the time and efforts invested. Thus, the greatest benefit and resource saving is achieved in planning and conceptual stage. At this point major information is established but before major design and development resources are spent.

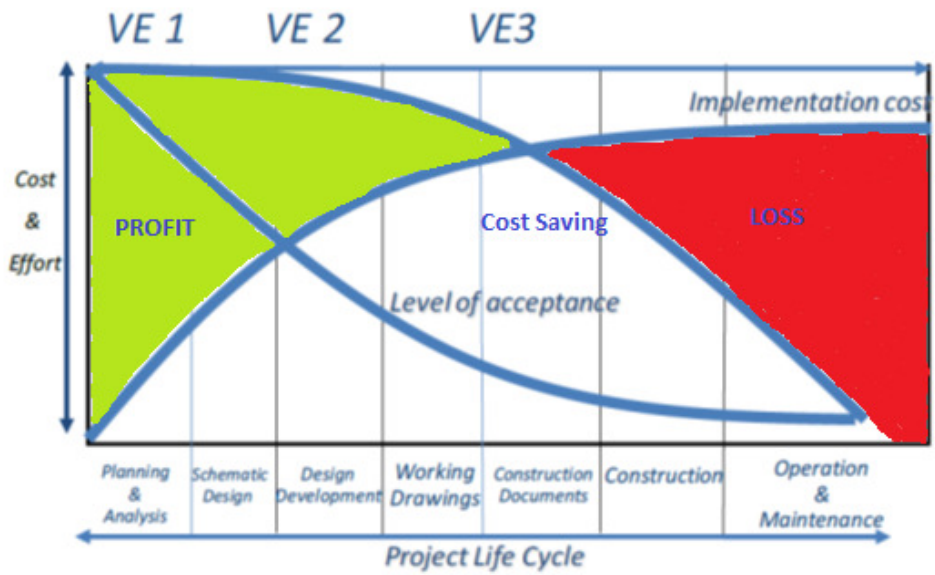

Figure 1: The stages of VE application

The three main stages of a construction project and VE application is as shown in figure 4.1.

4.1 Planning and schematic design (VE1)

The first VE study VE1 is applied during the planning and schematic design stage to define the project goals, functions, objectives, requirements, design criteria and scope of work. Benefit of starting VE at this stage is that project will be developed with fewer changes, redesigns and greater

understanding by all parties of what final function will be. Independent teams can bring alternative and creative solutions from other similar projects.

4.2 Design Development (VE2)

The second VE study VE2 is applied in design development stage to generate detailed VE proposals and alternatives to the design and to define technical systems. In this stage of VE, multiple design alternatives are considered and the most cost effective and overall efficient alternative is selected. Suggestions by other personal like constructor, designers are also taken for improvement.

4.3 Construction (VE3)

During this phase value engineering is still possible though the use of VE change proposal. But application of VE at this phase is generally costly and difficult to implement due to resistance to change.

4.4 Benefits of VE

Value engineering is used:

- To determine best design alternative
- To reduce cost
- To identify problems and develop solutions for them
- To improve quality
- To increase reliability, availability and customer
- To save time

5. SUSTAINABLE DEVELOPMENT AND SUSTAINABLE CONSTRUCTION

The construction industry has a vital impact on the environment and people. It contributes to environmental problems through resource depletion, energy consumption, air pollution and waste creation. Sustainable development is the development that meets the needs of present without compromising ability of future generations to meet their own needs. It is the balance between economic progress and environmental conservation needed for future survival. Sustainable construction is used to describe the application of sustainable development in the construction industry. Sustainable could also be alternatively defined as the creation and responsible management of a health built environment based on resource efficient and ecological principles.

Following principles are adopted to achieve sustainable buildings:

- High performance lighting
- Environment responsive site planning

- Acoustic comfort
- Visual comfort
- Energy efficiency
- Reuse of existing building assets.
- Thermal comfort
- Indoor air quality
- Reduction in pollution
- Safety and security
- Cost effectiveness

6. CONNECTION OF VALUE ENGINEERING AND SUSTAINABLE CONSTRUCTION

6.1 Importance of VE for sustainability

VE can be used as a tool for achieving sustainable construction but must be applied during early stages of a project. As sustainable construction brings additional value to projects, VE can be used to ensure that these values are maximized. The main issue for construction regarding sustainability are what to build, where to build, how to build and whether to build? and this is related to planning, design and construction. But VE plays important role in sustainability for generating significant funds in initial installation and operating cost. It is not only a management approach for construction industry but also is the best technique for producing best results in achieving value for money for client. The sustainable decision uses professional judgment and vision to distinguish between capital expenditure and operational expenditure.

6.2 Connection of VE with sustainable construction

VE job plan is a systematic approach for identifying problems and finding out solutions of them. It can raise sustainable construction principles and can give the techniques to help decision makers to take appropriate decisions and actions in order to realize value of project. Functional analysis enables the team members to apply sustainability issues in assigning components of a project. In creative phase of VE suitable alternatives for sustainability are generated and unsuitable alternatives are discarded.

To apply sustainability principles following steps are considered during project.

- For VE study experienced VE professional should be appointed.
- Consumption of non-renewable energy resources should be minimized.
- Protection and conservation friendly material should be adopted.
- Appropriate design and construction solutions are developed.

7. CONCLUSION

Value engineering is the best tool for achievement of sustainable construction. VE uses multi-disciplinary teams to analyze product design or construction approach. Sustainable construction is having valuable contribution to construction industry in the form of sustainability development. Sustainable construction is related to social, economic and environmental impacts of project. So for environmental protection, cost optimization and social improvement VE provides powerful tools and techniques to achieve sustainability in construction. This paper discussed conceptual linkage between value engineering and sustainable construction which can be helpful for further research.

REFERENCES

[1] *Value Standard and Body of Knowledge*, Save International; June2007.

[2] J. R. Wixon, *Value Engineering the Forgotten Lean Technique*, University of Idaho.

[3] J. S. Russel, *Constructability Related To TQM*. Value Engineering and Cost/Benefits.

[4] Al-Yami, A, *Exploring conceptual linkage between VE and sustainable construction.* Southborough University, Leicestershire, UK, 2005.

[5] Hill, R.C. and Bowen, P.A, *Sustainable construction: Principles and framework for attainment.* Construction Management and Economics, 1997.

[6] Abidin, N. Z. and Pasquire, C.L. (2005), *Delivering sustainability through value management, Engineering, Construction and Architectural Management*, 12(2), pp. 168-180.