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Application of Value Engineering Technique to A Residential Building –Case Study

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Abstract— The Value Engineering is an intensive, interdisciplinary problem solving activity that focuses on improving the value of the functions that are required to accomplish the goal, or objective of any product, process, service, or organization. Value Engineering is an effective problem solving technique. Value engineering is essentially a process which uses function analysis, team- work and creativity to improve value. Value Engineering can be applied during any stage of a project's design development cycle. However, the greatest benefit and resource saving are typically achieved early in the development and conceptual design stages. VE may be applied more than once during the life of the project.

Keywords— Value, Job plan, Functions, Cost, Worth

I. INTRODUCTION

The Value Engineering is an intensive, interdisciplinary problem solving activity that focuses on improving the value of the functions that are required to accomplish the goal, or objective of any product, process, service, or organization. Value Engineering stands to a reason that any technique so useful should be applied to every product, and at each stage of the normal day-to-day development of a building construction product. The practice of this technique requires a certain amount of expense, which may get justified by potential cost savings. Accordingly there must be a recognized need for change and a distinct opportunity for financial benefit to deserve the added cost of a value engineering effort. Value Engineering is a creative and disciplined process which seeks to offer the client a reliable opportunity for cost savings without detriment to quality or performance.

II. HISTORICAL BACKGROUND

During the World War II, General Electric Company (GE) faced the problem of scarcity of critical materials to fulfil the demand of the war equipment. To overcome that problem, GE had to use substitute materials for those in shortage. Many of the substitutes were less expensive and better in performance. In 1947, Lawrence D. Miles, a staff engineer for GE developed a number of ideas and techniques to select alternative materials that could be used internationally. His main attitude was to search for value in a product and he developed a function-based methodology that was successfully proven. The new methodology was so successful that it was possible to produce goods at greater production and operational efficiency and at lower costs. As a result of its success, GE formed a special group leaded by Larry Miles to refine the methodology. 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 Defense in 1961. [1]

III. VALUE ENGINEERING BENEFITS

According to research carried out by SAVE, VM methodology can increase customer satisfaction and add value to an organization's investment in any business or economic setting. Practitioners apply VM methodology to products and in industries such as the following: corporations and manufacturing, construction, transportation, government, health care and environmental engineering. Further from the research they found out that VM methodology easily produces savings of 30 % of the estimated cost for manufacturing a product, constructing a project or providing a service. The return on investment that public and private organizations derive from implementing VM programs averages 10 to 1. That is, for every dollar invested in a VM study, including participants' time and implementation costs, 10 dollars in net saving results. [3]

III. VALUE ENGINEERING METHODOLOGY

The value methodology is a systematic process that follows the Job Plan. The Job Plan consists of some phases. The recommended VE methodology (Job Plan) used by the VE team during the Workshop has five distinct phases. Briefly, these phases are:

A. Information Phase

The VE team gains as much information as possible about the project design, background, constraints, and projected costs. The team performs a function analysis and relative cost ranking of systems and sub-systems to identify potential high cost areas. [13] The information phase also includes preparation of the cost and energy models from cost data assembled before the workshop began. These models are updated based on information received during the Designer‟s presentation. [5]

B. Function and Creative Phase

The VE team uses a creative group interaction process to identify alternative ideas for accomplishing the function of a system or sub-system. [13] Functional analysis forces a broader and more comprehensive understanding of the project by

Stimulating intense discussion and by compelling the team to view aspects they might not normally have consideredVE team evaluates the ideas developed during the creative phase. [5]

C. Evaluation/Analytical Phase

The ideas generated during the Speculative/Creative Phase are screened and evaluated by the team. The ideas showing the greatest potential for cost savings and project improvement are selected for further study. [13] VE team evaluates the ideas developed during the creative phase. The VE team ranks the ideas. Ideas found to be irrelevant or not worthy of additional study are disregarded; those ideas that represent the greatest potential for cost savings and improvements are selected for development. [5]

D. Development/Recommendation Phase

The VE team researches the selected ideas and prepares descriptions, sketches and life cycle cost estimates to support the recommendations as formal VE proposals. [13] During the development phase of the VE study each designated idea is expanded into a workable solution. The development consists of the recommended design, capital and life cycle cost comparisons and a descriptive evaluation of the advantages and disadvantages of the proposed recommendations. [5]

E. Report Phase

The VE consultant will work in concert with the A-E and the PBS representative to produce a preliminary written VE Report which is intended to represent the results of the VE workshop activities, and meet the VE Program objectives. [13] The post-study portion of a VE study includes the finalization of the VE Report in order to incorporate the VE proposals developed during the workshop. The Designer then responds by accepting and incorporating the proposals into the project design, rejecting the proposals, or recommending further study. [5]

IV. DATA ANALYSIS

Masterformat is a standard for organizing specifications and other written information for commercial and institutional building projects and Uniformat is a standard for classifying building specifications, cost estimating, and cost analysis in the U.S. and Canada. The elements are major components common to most buildings. [6]

Case study of residential building has taken to study value engineering application. In this Master format and uniformat was prepared. After preparation of masterformat and uniformat next step is to apply Pareto Law 20/80. which comes through ranking of the function according to their costs in descending order. Normally, around 20% of the functions constitute around 80% of the cost. These functions (20%) are the subject of value engineering. Weight for each criterion is assigned to reflect relative importance based on the project attributes that has been clearly verified and defined.

TABLE I
FUNCTIONS OF UNIFORMAT RANKED IN DESCENDING ORDER

Code	Uniformat	Cost (Rs.)	% of the Total Cost	Accumulative Cost	% Accumulative
031	Flooring	2,90,520	15.00%	2,90,520	15.00%
043	Door & Window	2,52,520	13.04%	5,43,040	28.04%
022	Centering Work	2,23,476	11.54%	7,66,516	39.58%
051	Plastering	1,56,880	8.10%	9,23,396	47.68%
021	Slab	1,43,710	7.42%	10,67,106	55.1%
024	Beams	1,24,361	6.42%	11,91,467	61.52%
041	Painting	10,4000	5.37%	12,95,467	66.89%
061	Plumbing	1,00,000	5.16%	13,95,467	72.05%
011	Stepped Foundation	92,958	4.80%	14,88,425	76.85%
025	Brickwork	83,916	4.33%	15,72,341	81.18%
023	Column	81,386	4.20%	16,53,727	85.38%
092	Profit	76,000	4.00%	17,29,727	89.38%
081	Light and Power Distribution	75,000	3.87%	18,04,727	93.25%
042	Carpentry Work	62,600	3.23%	18,67,327	96.48%
091	General Condition & Overhead	36,906	1.90%	19,04,233	98.38%
101	Equipment	32,097	1.62	19,36,330	100%
012	Spec. foundations	0	0%	19,36,330	100%
052	Partitions	0	0%	19,36,330	100%
053	Specialties	0	0%	19,36,330	100%
06	Elevator	0	0%	19,36,330	100%

072	H.V.A.C	0	0%	19,36,330	100%
073	Fire protection	0	0%	19,36,330	100%
074	Special mechanical system	0	0%	19,36,330	100%
082	Special electrical system	0	0%	19,36,330	100%
	Total	19,36,330			

It was noticed that the first 6 items (out of 16) forms 61.53% of the total cost. This means 37.5% of the functions form 61.53% of the cost which is very closed to Pareto Law. As a conclusion, the area of value engineering analysis and study will be controlled by the first six functions that are listed in following table.

Code	Uniformat	Cost (Rs.)
031	Flooring	2,90,520
043	Door and Window	2,52,520
022	Cantering Work	2,23,476
051	Plastering	1,56,880
021	Slab	1,43,710
0214	Beams	1,24,361
Total		11,91,467

IV. CONCLUSIONS

Value Engineering can be applied during any stage of a project's design development cycle. However, the greatest benefit and resource saving are typically achieved early in the development and conceptual design stages. VE may be applied more than once during the life of the project. Early application of VE helps to get the project started in the direction, and repeated application helps to filter the project's direction based on new or changing information. It is important available and compare quality elements of the design with the owner's requirements. The application of Pareto Law 20/80 states that around 20 % of the functions constitute around 80% of the cost. These functions (20%) are the subject of value engineering. Likewise It was noticed that the first 6 items (out of 16) forms 61.53% of the total cost. This means 37.5% of the functions form 61.53% of the cost which is very closed to Pareto Law. As a conclusion, the area of value engineering analysis and study will be controlled by the first six functions. Further, we can do analysis of these functions and suggest alternatives and calculate cost model after application of value engineering technique.

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