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APPLICATION OF VALUE ENGINEERING IN BUILDING CONSTRUCTION

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Abstract- The current economic conditions have entailed the use of rational method and techniques and research and application of new techniques by utilizing advancements in technology in the field of production as well as in every field. Excess cost control requires to be maintained throughout the project life of building beginning from the initial stages of design. Scrutinizing the project well and considering all possible alternatives particularly in design stage are important for achieving optimum cost. 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 not essentially cost cutting, the main aim of value engineering is to increase the value but not to reduce cost. Each and every individual activity of conventional construction is taken and the best alternative materials are being searched. PRIMAVERA software is used in order to find the major elements based on Pareto principle.

Keywords – Value, Cost, Function, Time.

I. INTRODUCTION

Value engineering (VE) is a systematic method to improve the "value" of goods or products and services by using an examination of function. During the World War II, General Electric Company (GE) faced the problem of scarcity of critical materials to fulfill 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. In 1954, the U.S Navy Bureau of Ships used the Value Analysis process to cost improvement during design. They called it "Value Engineering". Value engineering is also referred to as "value management" or "value methodology" (VM), and "value analysis" (VA).

Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The owner's promises must also be given prior importance because those promises are key in attracting the customers. Reasons for poor value can be that, lack of information, decisions based on wrong beliefs, habitual thinking and

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reluctance to seek advice, shortage of time, changing technology, old specifications and poor human relations.

Value=function/overall cost

II. VALUE ENGINEERING METHODOLOGY

Value engineering is often done by systematically following a multi-stage job plan. 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 –

In the information phase, all the pertinent aspects of the project were studied and the whole information regarding the project design, background, constraints, equipment used, time taken and projected costs of each and every element are clearly collected. The information phase also includes preparation of the special tabular formats and check lists abiding to the rules of value engineering.

B. Analysis Phase–

In the analysis phase, the data collected is being analyzed clearly. The software used for the analysis of data is PRIMAVERA. All the individual elements are taken into consideration and the main activities which consume more cost are shortlisted and also the total budget for the project is generated in the form of report from PRIMAVERA.

C. Creative Phase–

In the creative phase, the alternative ideas for accomplishing the function of a system are made. The major work that is done in this phase is to fix the alternative materials which must be substituted with the existing materials in the conventional construction. The ideas developed in this phase should be such that the quality must not be affected. The ideas developed during the creative phase are to be evaluated and developed so that they can be recommended and implemented.

D. Evaluation Phase –

In the evaluation phase, the ideas generated during the 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. The alternative materials suggested in place of conventional materials are also processed in PRIMAVERA.

E. Report/Presentation Phase–

In the Report Phase, the alternatives which are evaluated are to be implemented and a Report is being generated from PRIMAVERA showing differences in cost for each and every activity. The variation of cost is also being presented in this phase.

III. DATA ANALYSIS

The data collection is done by following the philosophies of information phase. Aim of the data collection is to know the problem well. Data gathered from interviewing and collecting project related materials from owner, contractor and designer concerned with the project undertaken.

Case study of residential building has taken to study value engineering application. For this a report is generated from PRIMAVERA, for this all the data regarding costs, relationships, resources are to be given. After getting the data about cost, next step is to apply Pareto Law 20/80. Pareto Law states that only 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 -1 Detailed Cost of Existing Structure

Activity ID	Activity Name	Start	Finish	Budgeted Total Cost
A1000	SOP	01-Aug-14	21-Nov-14	Rs0.00
A1020	Soil Testing	01-Aug-14	05-Aug-14	Rs8,000.00
A1030	Architect Plan	01-Aug-14	03-Aug-14	Rs4,800.00
A1040	Estimations	06-Aug-14	08-Aug-14	Rs1,600.00
A1080	Clearing the Site	26-Aug-14	26-Aug-14	Rs102,000.00
A1090	Pit Excavation	27-Aug-14	19-Sep-14	Rs338,000.00
A1110	Shuttering for Footings	21-Sep-14	01-Oct-14	Rs79,000.00
A1120	Concreting of Footings	03-Oct-14	05-Nov-14	Rs199,000.00
A1130	Shuttering for Columns and Beams	24-Nov-14	02-Dec-14	Rs406,400.00
A1140	Concreting of Columns and Beams	03-Dec-14	26-Dec-14	Rs395,250.00
A1150	Stair Case	27-Dec-14	12-Jan-15	Rs220,850.00
A1160	Shuttering of Slab and Laying Electrical Pipes	13-Jan-15	20-Jan-15	Rs3,347,200.00
A1170	Concreting the Slab	21-Jan-15	28-Jan-15	Rs478,827.27
A1180	Construction of Brick Walls	30-Jan-15	20-Apr-15	Rs5,400,000.00
A1190	Plastering of Walls	21-Apr-15	25-May-15	Rs3,151,000.00
A1210	Lift1	24-Apr-15	27-May-15	Rs900,000.00
A1215	Lift2	24-Apr-15	27-May-15	Rs900,000.00
A1220	False Ceiling	26-May-15	17-Jul-15	Rs1,350,000.01
A1230	Flooring	18-Jul-15	13-Sep-15	Rs8,669,227.00
A1240	Laying Tiles in Kitchen and Bathroom	18-Jul-15	21-Aug-15	Rs1,497,960.00
A1250	Flooring in Corridor and Stair Case	18-Jul-15	09-Aug-15	Rs719,200.00
A1255	Flooring in Parking and Cellar	10-Aug-15	01-Sep-15	Rs1,334,000.00
A1280	Wiring and DB Installations	22-Aug-15	04-Dec-15	Rs3,375,000.00
A1310	Running Main Water Pipeline from Tank	05-Dec-15	19-Mar-16	Rs4,050,000.00
A1320	Installation of Water Tank	05-Dec-15	08-Jan-16	Rs100,000.00
A1350	Fixing Door Frame	24-Apr-16	08-Jun-16	Rs2,835,000.00

A1360	Fixing Door Shutter	09-Jun-16	13-Jul-16	Rs5,850,000.00
A1370	Fixing Windows	09-Jun-16	06-Aug-16	Rs3,060,000.00
A1380	Texture	07-Aug-16	17-Aug-16	Rs59,400.00
A1390	Putty	18-Aug-16	31-Aug-16	Rs793,920.00
A1400	Weather Shield	01-Sep-16	12-Sep-16	Rs660,870.00
A1410	Lappum	13-Sep-16	05-Oct-16	Rs2,170,000.00
A1420	Plastic Emulsion	06-Oct-16	29-Oct-16	Rs1,240,000.00
A1430	Wood Enamil	30-Oct-16	09-Nov-16	Rs344,000.00
A1440	Door Polish	10-Nov-16	21-Nov-16	Rs150,594.00
A1450	EOP		21-Nov-16	Rs0.00
Total		01-Aug-14	21-Nov-16	Rs5,44,50,398.57

Table-1 shows the cost of each and every element and also the duration. It was noticed that the first 7 items (out of 17) forms 67% of the total cost. This means 35% of the functions contribute 67% of the cost which is much close to Pareto Law. The area of value engineering analysis and study will be controlled by the first six functions that are listed in following table.

Table -2 List of Activities consuming more cost

Sr. No	Work done	Cost(Lakhs)
1	**Flooring**	**87**
2	**Doors**	**70**
3	**Brick Wall**	**54**
4	**Plumbing**	**41.5**
5	**Shuttering**	**38.5**
6	**Kitchen , corridor**	**36**
7	**Electricity**	**33**
8	**Plastering**	**31.5**

Table-2 shows the activities in descending order which are consuming more cost. These activities can also be named as major activities. So according to Pareto Law if maximum savings are to be obtained then the alternative materials are applied to these elements which are consuming more cost.

IV. RESULTS AND CONCLUSIONS

The following alternative materials are being opted in place of the conventional materials. These materials are opted by considering many factors. Following are the alternative materials which are being replaced by the new alternative materials:

Table-3 Alternative Materials opted

Sr. No	Conventional Materials	Alternative Materials

1	**Clay Bricks**	**AAC Blocks**
2	**Vitrified Tiles**	**Marble Flooring**
3	**Internal Teak doors**	**Teak Veneer Doors**
4	**Cement Plastering**	**Gypsum Plastering**
5	**Marble Flooring on Staircase**	**Flamed Granite**
6	**River Sand**	**Robo Sand**

Table-3 shows all the activities which are being replaced with alternative materials. Clay bricks are replaced with AAC Blocks, Vitrified Tile flooring is replaced with Marble Flooring, Internal Teak doors are replaced with Teak Veneer doors, Cement Plastering is replaced with Gypsum Plastering, Marble flooring on staircase is replaced with Flamed Granite and River Sand is replaced with Robo Sand.

Following are the results obtained by substituting the above mentioned materials with the conventional construction:

1. By substituting these alternative materials, time of the project is reduced from 753days to 723days
2. By substituting these alternative materials, cost of project is reduced from INR5,44,50,398 to INR4,78,17,971
3. Total time saved in the project by substituting the alternative materials is 30Days
4. Total cost saved in the project by substituting the alternative materials is INR 66Lakhs
5. 12% of difference is obtained in case of cost
6. 6% of difference is obtained in case of duration

From the following results it is clear that without affecting the quality, cost of the construction can be reduced. Following things can be concluded from the results obtained:

1. Cheaper alternative materials are available in the market which satisfies the functions and requirements of the work.
2. Reducing the cost of construction is only possible when new materials are being invited and accepted in the Construction
3. Quality is maintained at desired level because there is no question to reduce cost at the expense of quality.
4. People thinking must change to accept the change in construction materials, ultimately leading to cut down the increasing construction costs without compromising in quality leading to increase in the construction value.

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