Imperial Journal of Interdisciplinary Research (IJIR)
Vol-2, Issue-11, 2016
ISSN: 2454-1362, http://www.onlinejournal.in

Application of Value Engineering in Road Construction Project

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Abstract— *The current construction practices require a great effort to balance the factors such as money, time and quality. Comparing with other industries it seemed that construction industry remains the toughest one to deal with. It is proven that certain modern techniques can be easily adapted to the project to balance the factors above said. Value engineering is an efficient tool among them for fostering the construction quality with an aim of low cost and high services. The value engineering is a methodology used to analysis the function of the goods and services and to obtain the required functions of the good and service of the user at the lowest total cost without reducing the necessary quality of performance. It 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. In this paper we have discussed the concept of Value Engineering and the effective implementation of it through a case study.*

Keywords*—Value Engineering, Methodology, Functions Analysis, Reduced Cost.*

I.INTRODUCTION

Value Engineering can play a key role in ensuring that programs stay within budget or even save money. Value engineering, being a very creative and effective approach, must be appreciated and understood at all level of the project management and must be accepted worldwide. The term "value management" is used nowadays in India instead of "value engineering" because it is more a management function than an engineering technique.Value engineering is a management tool to achieve essential functions of a product, service or project with the lowest cost. VE has become a standard practice for many government agencies and private engineering firms and contractors since its first adoption in the 1950s. It has been widely practiced in the construction industry and become an integral part in the development of many civil infrastructure projects.VE has been practiced for half a century in the construction industry with an aim to produce innovative ideas and solutions for enhanced project value. Value Engineering or Value Management is one of the important project management tool, it can be defined as the systematic effort directed at analyzing the functional requirements of systems, equipment, facilities, procedures and supplies for the purpose of achieving the essential function at the lowest total cost, consistent with meeting needed performance, reliability, quality, maintainability, aesthetics, safety and fire resistance. VM as a management style focuses on value system evolution and resolution within projects, or organizational systems for that matter, by bringing the right team of stakeholders together at the right time. Through a structured, challenging, analytical and mediated process it permits value systems to coalesce to the benefit of the commissioning organization, regardless of whether the VM service is offered internally within an organization or is commissioned externally.

II.LITERATURE REVIEW

1. **Amruta Chougule 2014-** In this Paper Value engineering methodology is explained briefly with suitable example. They explained the Job Plan method briefly. In case study of residential building has taken to study value engineering application. In case study she noticed around 20% of the function constitute around 80% of the cost. These functions (20%) are the subject of value engineering. Value engineering can be applied during any stage of a project's design development cycle. It is very useful tool to get good quality work in lower cost with using alternatives on that 20% functions. When we use Value engineering in earlier stage of project it is more beneficial than using it in development stage for saving resources. From the case study they suggested to give alternative to the functions to reduce the project cost.

2. **SenayAtabay and Niyazi Galipogullari 2013-** In this paper they discussing about the importance of value engineering. 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. The highest performance in VE is achieved especially when the purpose is mainly increasing the value rather than reducing the costs. Production methods developed with VE are carried out to reduce the cost of a product without sacrificing the quality, keeping the cost fixed by increasing the quality or shortening the production time.

3. **Neetu B. Yadav, Rakesh Kacha 2013-** In this paper they discussed the history of Value engineering related infrastructure development. Again, apart from the huge amount associated, construction sector has verities of construction projects involving large number of stakeholders, materials, construction and management techniques, et al. which states a wider scope of application of the value engineering/management. Considering the characteristics of the Indian construction industry, it would be possible through VE studies to identify and overcome the various loop holes with creative alternatives which will result into higher productivity, cost reduction, better performance, better quality, simpler design (Civil, structural, mechanical, etc.) and optimum project duration without affecting the function of any project or service.

4. **Amit Sharma, Dr. R.M.Belokar 2012-** In this paper the case study discussed how the cost of a product is minimized by applying the Value Engineering Methodology. Various worksheets are developed and thorough analysis is done to attain a concrete solution. In future we can make the changes in the design so that the Value of the product can even be enhanced. Value Engineering is the systematic application of recognized techniques by a multi-disciplined team which identifies the function of a product or services; establishes a worth for that function; generates alternatives through the use of creative thinking; and provides the needed functions to accomplish the original intent of the project, reliably and at the lowest life-cycle without sacrificing project requirements for safety, quality, operations, maintenance and environment.

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. The information phase also includes preparation of the cost and energy models from cost data assembled before the workshop began.

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. 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 considered VE team evaluates the ideas developed during the creative phase.

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. 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.

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. 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.

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 objective. 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.

IV. DATA ANALYSIS

Case study of a cement concrete road construction site has taken to study value engineering application.

Name of Road	B.J.Patel Road, Goregaon (Wes), Mumbai
Type of Road	Flexible Road
Length of Road	1070 m
Width of Road	13.4 (2 Lane)
Total Cost(Phase 1)	105145510 Rs.

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

Sr.No.	Item Name	Cost (INR)	% of total cost	Accumulative cost	% Accumulative
1	GSB	5,936,760.00	9.9248231	5,936,760.00	9.9248231
2	WMM	10,850,560	18.139505	16,787,320.00	28.064328
3	DBM	6,950,400.00	11.619383	23,737,720.00	39.683712
4	M-15	2,301,210.00	3.8470651	26,038,930.00	43.530777
5	STEEL	4,147,268.00	6.9332264	30,186,198.00	50.464003
6	KERB	3,266,920.00	5.461498	33,453,118.00	55.925501
7	BARRICADING	3195460	5.3420342	36,648,578.00	61.267535
8	WALL N SLAB SHUTTERING	1421100	2.3757346	38,069,678.00	63.64327
9	EXCAVATION	3,440,810.00	5.7521999	41,510,488.00	69.39547
10	WT	2,342,320.00	3.915791	43,852,808.00	73.311261
11	BC	6,935,920.00	11.595176	50,788,728.00	84.906437
12	THERMOPLAST	248,800.00	0.4159333	51,037,528.00	85.32237
13	60 MM PAVER BLOCK	2,598,260.00	4.3436606	53,635,788.00	89.666031
14	80 MM PAVER BLOCK	6,181,500.00	10.333969	59,817,288.00	100
	Total	59,817,288.00			

It was noticed that the first 10 items (out of 14) forms 73.3% of the total cost. This means 23.07% of the functions form 73.3% 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 three functions that are listed in following table.

Sr.No.	Item Name	Cost (INR)
1	GSB	5,936,760.00
2	WMM	10,850,560.00
Total		16,787,320.00

VI. 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 3 items (out of 13) forms 73.3% of the total cost. This means 23.07% of the functions form 73.3% 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 three functions.

VII.ACKNOWLEDGMENT

I would like to express my gratitude towards my respected guide Prof. Hemanshu Ahire sir for his constant encouragement and valuable guidance during this work. Also I m thankful to Mr. Pravin Bhurke sir who gave us details of infrastructure project(road) for case study of this dissertation. And also to express gratitude towards all those who helped me directly or indirectly in many ways in complication of this research work.

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