Implementation of Value Engineering in Construction Management

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Abstract: *Infrastructure development in the construction sector is a crucial driver of the country's socioeconomic growth. Because the building sector is so important to the country's economic growth and development, it requires competent construction processes that are both cost effective and time efficient. This paper explains the fundamentals of value engineering and the many strategies that may be used to optimise time. Value engineering is particularly significant in terms of quality, dependability, durability, and improving performance throughout the project's life cycle.*

Keywords: Value Engineering, Time Reduction, Quality, Construction

I. INTRODUCTION

The role of value engineering has expanded in recent years in the building sector The role of value engineering essential function in terms of quality, dependability, and enhancement project execution performance During the building process, several approaches such as "CLC brick walls," "Granite tiles," and "Mivan technology" are effective for time optimization, which falls under value engineering. Infrastructure development in the construction sector is a crucial driver of the country's socioeconomic growth. Because the building sector is so important to the country's economic growth and development, it requires competent construction processes that are both cost effective and time efficient. This paper explains the fundamentals of value engineering and the many strategies that may be used to optimise time. Value engineering is particularly significant in terms of quality, dependability, durability, and improving performance throughout the project's life cycle.

1.1 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.

1.2 Scope of Value Engineering

- **What is Required**: If the cost and time estimate is over budget, the project is required to go through a time reduction phase that brings the project back in line with the approved budget.
- **Who to See**: The entire design team and project management team must be involved in balancing the cost and time so that good decisions are made for the benefit of the entire project. This meeting(s) will be organized by the Project Manager.
- **What will Happ**en: Three basic strategies are employed to reduce the cost and time on capital projects – value engineering, alternatives and scope reduction.
- **Value Engineering**: VE is the process of finding systems or methods of achieving the same programmatic goals using a different system that do not materially affect the desired outcome

1.3 Advantages of Value Engineering

- Value engineering is used:
- Value engineering cuts costs

- Value engineering improves the quality of the building
- Value engineering reduces waste
- 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
- To increase safety.

1.4 Statement of the Problem

To do value engineering for residential and commercial construction in order to improve project tracking and cost efficiency. Data analysis on two case studies will be performed. Rate analysis, steel quantities, concrete quantities, and other factors will be evaluated, and the analysis will be performed in MSP software

II. LITERATURE REVIEW

2.1 Li Ning (2017) Conducted research on "Cost Control Application Research of Value Engineering in the Design Phase of Construction Project" Value engineering, a subject about technology and economy dedicated to improve the function of product or system, and reduce the cost of product or system, therefore with the lowest life cycle cost to meet customers' requirements about function. The application of value engineering focuses on the design phase of the research of development of the product, which is an important characteristic of value engineering. Compared with other countries, there is certain disparity in both the theoretical research and practical application of value engineering in the construction industry in our country. Therefore we have to catch up. So using value engineering methods to control cost in the most productive phase of value engineering design phase bears great practical significance. At abroad, the construction industry is the main area applying value engineering. In China, apart from industry business, the construction industry is the most important area involving the application of value engineering. But a study made by Guangdong construction industry shows that many enterprise managers don't have a clue about the value engineering. At present, the value engineering in construction industry is still at quite a low level. The popularization and application of value engineering in construction industry will make it easier for the construction industry eradicate the problems of long construction period, large waste, poor quality and high cost. Value engineering can make up for the shortcomings of these methods, for it studies allocation of product's properties and its cost based on its functions, and it emphasizes the organic combination of the improvements of products' function and the reduction of the cost. As long as the value engineering is practically popularized, the appearance of construction industry is bound to change.

Following are the main findings from above:

- Value engineering can make up for the shortcomings of these methods, for it studies allocation of product's properties and its cost based on its functions, and it emphasizes the organic combination of the improvements of products' function and the reduction of the cost.
- The construction industry is the main area applying value engineering. In China, apart from industry business, the construction industry is the most important area involving the application of value engineering.

2.2 Kavoos Amirkhani (2015) Conducted research on "Effect of Value Engineering in construction and project management" Given that construction projects are time-consuming and costly, can be with offer and use of new techniques in the management of the project was to reduce these two factors, value engineering is one of the new techniques reduce the cost of a project that can be with value engineering studies and the use of all items of a project to achieve the optimal result In The value engineering with use of person's creativity can be lead to ways to reduce the cost of the project; lake of application of value engineering in project creates many problems that are no secret on nobody of the project managers. In this study, tried to value engineering concepts is examined application of value engineering on the project and its effects in project management and economy.

Following are the main findings from above:
- In this study, tried to value engineering concepts is examined application of value engineering on the project and its effects in project management and economy.

2.3 Venugopal Sharma (2016) Conducted research on "Analysis To Reduce Cost Through Value Engineering Of Furniture Product In Furniture Industry" The Value Engineering process and procedures are generally well defined and well-understood at all levels in the industry. Value Engineering is recognized as an effective tool to improve the performance of a product with reduction in cost without reducing in quality. . A proper decision matrix is prepared for choosing the appropriate alternative from the feasible choices available. The total saving which can be incurred per product by the implementation of above recommendations are 14.87 % for alternative-I and 27.44 % for alternative-II. Change in Technology and Globalization can rapidly increase which creates huge demand but not necessary for the same types product at the same price tags. These forcing companies think differently and look at their cost and create product to meet needs of market and trends. Following are the main findings from above:
- The total saving which can be incurred per product by the implementation of above recommendations are 14.87 % for alternative-I and 27.44 % for alternative-II.
- Change in Technology and Globalization can rapidly increase which creates huge demand but not necessary for the same types product at the same price tags

2.4 M. Ravish (2016) Conducted research on "A Study On Application Of Value Engineering In Residential Building Projects"Value engineering is a combination of technical and economic subjects. It is committed with the lowest life cycle cost and reliable completion of the functions required by the user. 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. It has an important influence and function to promote the traditional product value innovation, cultivate and develop the enterprise's core competitiveness, and promote national economic and social sustainable development. This project analyzes the current situation of construction project management and problems based on an overview of relevant theory of value engineering and construction project management. It Points out the importance of value engineering. Finally analyzes the application of value engineering to construction projects in various stages of the life cycle. Following are the main findings from above:
- Value engineering is a combination of technical and economic subjects.
- Value Engineering can be applied during any stage of a project's design development cycle.

2.5 Mr. O. Arivazhagan (2017) Conducted research on "Application of Value Engineering in Construction Job Sites – A Case Study"Value Engineering (VE) is a function-oriented technique that has proven to be an effective management tool for achieving improved design, construction, and cost-effectiveness in various transportation program elements. Value Engineering is one of the most effective techniques known to identify and eliminate unnecessary costs in product design, testing, manufacturing, construction, operations, maintenance, data, procedures and practices. In this study, a questionnaire survey was conducted for Tamilnadu State, India. The questionnaire survey mainly focuses on how effectively value engineering is applied in construction industry and how much the employees are aware of the concept of value engineering and its effectiveness. It is observed that at the initial stage the employees have very good awareness and in due course of project the awareness has gradually reduced. It is concluded that 20 percentage of them are not following specific procedure for implementing value Engineering and remaining 80 percentage following Value Engineering. Following are the main findings from above:
- Value Engineering is one of the most effective techniques known to identify and eliminate unnecessary costs in product design, testing, manufacturing, construction, operations, maintenance, data, procedures and practices.

2.6 Jianyu Zhao (2019) Conducted research on "Real-time resource tracking for analyzing value-adding time in construction" Improving the effectiveness of production control has attracted the interest of researchers and lean construction practitioners over recent years, through techniques such as Last Planner System (LPS) and Location-based Management System (LBMS). However, in these techniques, data collection and analysis still remain manual. Remotely

locating workers on site has been suggested as a potential technology to collect crucial data required for production control. The purpose of this study is to test the applicability of a real-time tracking system for collecting data for production control in different types of construction projects. We applied Bluetooth Low Energy (BLE) technology in real-time tracking of workers in three case projects, including residential, office building, and plumbing renovation. We compared various tracking device placement strategies and analyzed the share of uninterrupted presence of workers in work locations based on the collected data. The findings show that both location-based and time-based information of workers can be obtained in real time from the proposed system, but issues of accuracy and coverage need to be considered when defining the data collection plan for each project. Accuracy and coverage issues can be resolved to a significant degree by applying heuristics in data analysis rather than investing in a more sophisticated tracking technology. The conclusion is that real-time tracking technologies are ready for implementation when certain heuristics and guidelines for installation are followed. It is possible to calculate a real-time presence index on a construction site. These data could be used to evaluate the impact of construction management interventions on waste on-site.

Following are the main findings from above:
- The findings show that both location-based and time-based information of workers can be obtained in real time from the proposed system, but issues of accuracy and coverage need to be considered when defining the data collection plan for each project.
- The conclusion is that real-time tracking technologies are ready for implementation when certain heuristics and guidelines for installation are followed.

2.7 Amit Sharma (2017) Conducted research on "Achieving Success through Value Engineering: A Case Study" Value Engineering is an organized/systematic approach directed at analyzing the function of systems, equipment, facilities, services, and supplies for the purpose of achieving their essential functions at the lowest life-cycle cost consistent with required performance, reliability, quality, and safety[1]. Society of Japanese Value Engineering defines VE as: "A systematic approach to analyzing functional requirements of products or services for the purposes of achieving the essential functions at the lowest total cost" In this paper we have discussed the concept of Value Engineering, its job plan and the effective implementation of it through a case study. Efforts have been put into the articulation of the paper to make it coherent which can be easily perceivable. A case study has been discussed in this paper involving a part used in the medical instruments. The material is chosen such that the cost is reduced without affecting the quality of the product. The best feasible solution from the available alternatives is chosen through the feasibility ranking table. Through the application of Value Engineering profits are maximized without hindering the reliability of the product. With the effective utilization of the technique the final outcomes comes out to be a successful showcase of value engineering.

Following are the main findings from above:
- In this paper discussed the concept of Value Engineering, its job plan and the effective implementation of it through a case study.
- Value Engineering defines VE as: "A systematic approach to analyzing functional requirements of products or services for the purposes of achieving the essential functions at the lowest total cost"
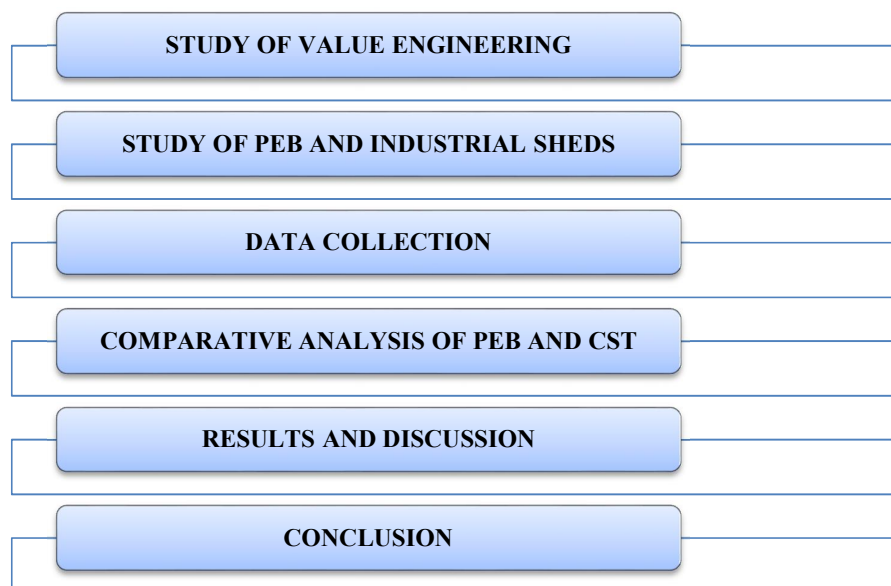
2.8 K. Ilayaraja(2019) Conducted research on "Value Engineering in Construction" Construction industry is an index of growth of a nation. The real estate sector in India has assumed growing importance with the liberalization of the economy. Today, the construction industry is the second largest employing skilled and semiskilled labor after agriculture and plays an important role in nation's economy. Due to increase in business opportunity and migration of labor, the demand for commercial and housing spaces has also increased. According to the tenth five-year plan, the estimate of shortage in urban housing is accessed to be 8.89 million units. As of now, the housing and construction industry employs 30 million people and about 250 industries are associated with construction industry directly or indirectly. It includes hospitals, schools, townships, offices, houses and other buildings as well as urban infrastructure, highways, roads, ports, railways, airports, dams, power plants Value engineering is a methodology used to analyze the function of the goods and services and to obtain the required functions of the user at the lowest total cost without reducing the necessary quality of performance. Many a time, Value Engineering (VE)is confused with cost cutting exercises in construction industry. The essential difference between conventional cost cutting and VE is that it involves reducing the cost by improving the functionality

through lesser consumption of energy in terms of manpower, materials and machines. In the initial stages VE was used by production engineers for reducing the cost of manufacture. However, it was found that the benefit of VE is much greater if multidisciplinary teams of engineers were involved which would also influence the design team that is normally the case in construction. Following are the main findings from above:

- However, it was found that the benefit of VE is much greater if multidisciplinary teams of engineers were involved which would also influence the design team that is normally the case in construction.
- Value Engineering is confused with cost cutting exercises in construction industry.

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III. METHODOLOGY

The value methodology is a systematic technique used by a diverse team to increase the value of a project via function analysis.

STUDY OF VALUE ENGINEERING

STUDY OF PEB AND INDUSTRIAL SHEDS

DATA COLLECTION

COMPARATIVE ANALYSIS OF PEB AND CST

RESULTS AND DISCUSSION

CONCLUSION

III. DATA COLLECTION AND DATA ANALYSIS

3.1 The Study's Objectives

Value engineering is still in its infancy in developing countries, and Iran is no exception.In order to react to changes, modern managers must improve the organization's strategy and policies. Value engineering is a term used to describe the process As one of the most successful management tools, it plays an important role in resource planning and management. Many To take advantage of the prospects, factors must be taken into mind about administrative experts in Iran. Value engineering was used to deliver these services in order to cut project costs as much as possible. Throughout the In this study, researchers looked into the various influencing elements in value engineering (VE) in the context of Iran's implementation The following research objectives were studied in order to achieve this goal:

1. To identify factors which hinder value engineering implementation in construction industry of Iran.
2. To establish essential needs of value engineering utilization in Iran

3.2 Result of the Study

A four-part questionnaire was utilised to find out more about the study's stated aims. the technique for gathering data The study's collected data and the findings of its analysis are presented in this chapter. The above-mentioned goals have been provided.

No.	Item	Percentage				M.I.
		Disagree	**Moderate**	**Agree**	**Strongly Agree**	
1	Lack of local guidelines and information	3.57%	5.35%	16.07%	75%	3.62
2	Lack of knowledge and practices	8.93%	7.14%	26.78%	57.14%	3.32
3	Interruption to normal work schedule	8.93%	19.64%	26.78%	44.64%	3.07
4	Change in owners' requirements	10.71%	10.71%	19.64%	58.93%	3.26
5	Conflict of objectives by different project stakeholders	7.14%	12.5%	32.14%	48.21%	3.21
6	Outdated standards and specifications	1.78%	3.57%	8.93%	82.14%	3.64
7	Habitual thinking and negative attitude	1.78%	5.35%	14.28%	76.78%	3.62
8	Lack of culture to accept the change	3.57%	12.5%	30.35%	48.21%	3.12
9	Over-design and overestimating	1.78%	10.71%	25%	55.35%	3.19
10	Lack of communication and poor human relations	5.35%	16.07%	21.42%	53.57%	3.16
11	Lack of inventive ideas	3.57%	14.28%	26.78%	48.21%	3.05

Table 1: Value engineering hindering factors in Iran

As can be seen from the table above, the participants of the study were polled on eleven major impediments to value engineering adoption in Iran. Outdated standards and specifications, habitual thinking and negative attitude, lack of local rules and information, lack of knowledge and practises were the five primary elements with the highest mean index, according to the gathered data and based on the mean index of the scores. Change in owners' attitudes toward these elements in order to remove roadblocks to value engineering application in Iran's building industry.
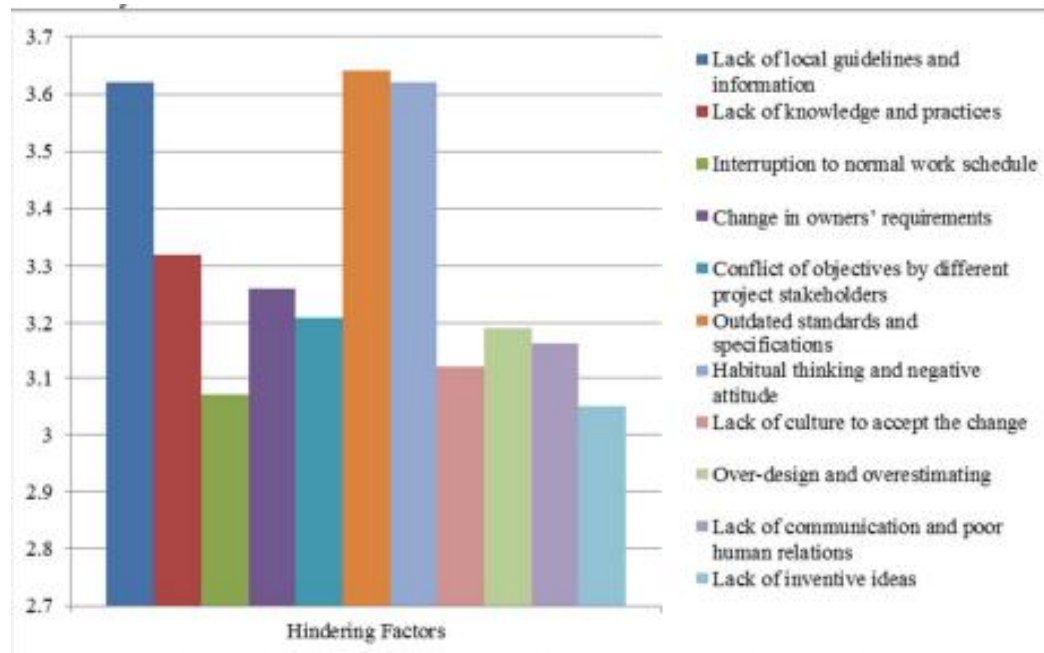
Graph 1: Mean index of value engineering implementation hindering factors

Five variables have been selected as the most troublesome out of eleven criteria that have been questioned from the respondents based on the mean index and the participants' thoughts about the problems that hamper the application of value engineering. Outdated standards and specifications, habitual thinking and negative attitude, lack of local guidelines and information, lack of expertise and practises, and change in owners' expectations are the most challenging aspects for value engineering implementation, as shown in Graph 1.

3.3 Results of the Second Objective of the Study (Needs for Value Engineering Utilization in Iran)

In this part, the results of second objective of the study have been presented. In order to achieve the third objective of this study, seven factors which are essential to improve value engineering utilization obtained from interviews. These factors had used to design the questionnaires to be asked about their necessities. The results have shown in the following tables and figures.

No.	Item	Percentage				M.I.
		Disagree	**Moderate**	**Agree**	**Strongly Agree**	
1	The importance of adding Value Engineering Change Proposals (VECP) clause in the Contract Document	10.71%	8.93%	19.64%	60.71%	3.50
2	Necessity of the presence of a Value Engineering Certified Personnel in design team	10.71%	12.5 %	21.42%	55.35%	3.35
3	The necessity of providing Value Engineering training opportunities for experts and students	5.35%	8.93%	26.78%	58.93%	3.39
4	The necessity of improving the communication and social skills of engineering students during their study	7.14%	8.93%	23.21%	60.71%	3.37
5	The criticality to provide the emergence of a diversity of procurement routes for projects	7.14%	10.71%	19.64%	62.5%	3.37
6	The necessity of making clients more demanding and knowledgeable of the Value Engineering	3.57%	7.14%	21.42%	66.07%	3.84
7	Essentiality of updating standards and criteria in construction industry in the participants' countries	5.35%	8.93%	23.21%	62.5%	3.42

Table 2: Value engineering utilization needs in Iran

According to the above table and based on the mean index of the participants' ideas regarding the essential needs for value engineering implementation in the context of Iran, three essential factors for value engineering utilization in Iran were: The necessity of making clients more demanding and knowledgeable of the value engineering, The importance of adding value engineering Change Proposals (VECP) clause in the Contract Document, and Essentiality of updating standards and criteria in construction industry in the participants' 434countries. So based on the results of the study and due to the participants' opinions regarding the essentiality of the mentioned factors in value engineering implementation in the context of Iran, the mentioned factors should be considered by different people in charge with construction projects of that country.
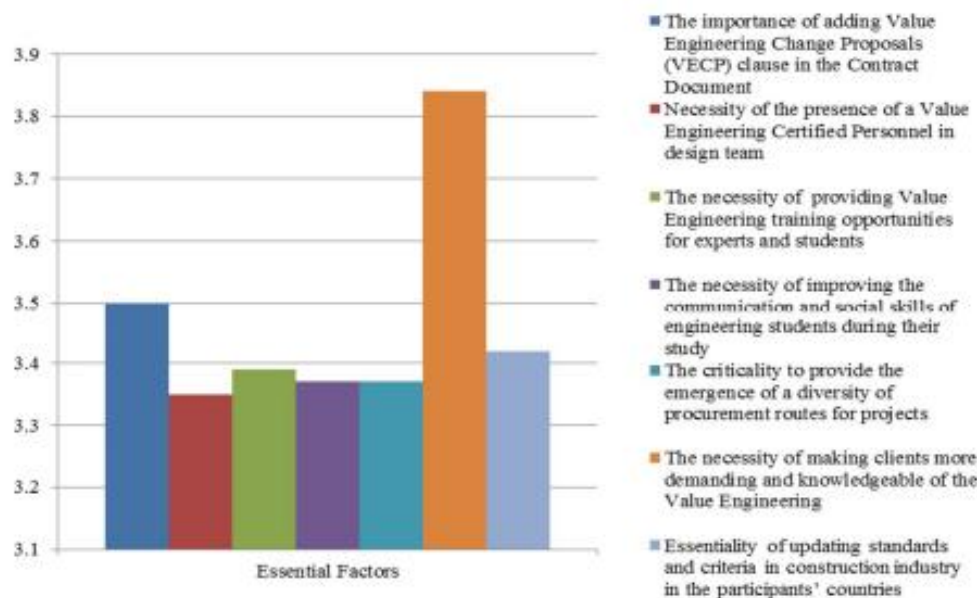
Graph 2: Needs of value engineering utilization in Iran

As it has been indicated in graph2, and based on the result of second objective, after surveying respondents' opinions regarding the needs of value engineering utilization in the context of Iran, three items have been identified as the most important factors out of the seven items that have been asked from the respondents. The most important factors regarding the needs for value engineering utilization in Iran are: The necessity of making clients more demanding and knowledgeable of the value engineering, the importance of adding value engineering Change Proposals (VECP) clause in the Contract Document, and essentiality of updating standards and criteria in construction industry in the mentioned scope.

IV. CONCLUSION

It was suggested that applying value engineering by a multidisciplinary team improves value and economy by studying alternative design ideas, materials, and building processes without sacrificing functional requirements and quality. In this article, multiple formwork and material strategies are employed to execute value engineering. As a result, value engineering strategies may aid in shortening the length and increasing the pace of a building project.

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