WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Leveraging Value Engineering in Heavy Highway Construction: Enhancing Cost Efficiency and Project Delivery

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ABSTRACT

This paper explores the application of value engineering (VE) in heavy highway construction, emphasizing its potential to enhance cost efficiency and project delivery. The construction industry often faces significant challenges, including project delays, budget overruns, and deficiencies in quality, which impede its growth and effectiveness. Through an analytical approach, this study investigates the effectiveness of VE as a systematic method for optimizing resources while maintaining or improving project functionality. The research identifies various factors that hinder the successful implementation of VE, including inadequate support from stakeholders, lack of standards, and insufficient skills within project teams. Furthermore, a case study illustrates the impact of VE on project costs, with a notable 20% reduction achieved through strategic material and method optimizations. Ultimately, the findings highlight the necessity for broader adoption of value engineering practices within the construction sector to address persistent inefficiencies and fulfill community needs, thereby underscoring the importance of training and resource commitment for successful VE application.

Keywords: Construction Challenges, Construction Management, Infrastructure Quality, Project Optimization, Resource Management, Value engineering.

1. Introduction

The construction industry is very important for a country's growth. The success of any project depends on how well it meets goals related to cost, quality, usefulness, and how long it lasts (Perpetua, 2019). However, the devastating results of highway construction projects in many countries have been a big concern. Many highway construction projects are often late and cost more than planned. Those that do finish on time often have bad quality and fall apart before they are supposed to. Poor performance is also a problem in the construction industry (Meyer et al., 2020).

Research shows that construction projects and the industry have not done well in both developed and developing countries, according to Takim and Akintoye (2022). There are several reasons why construction projects can be delayed and have problems, as noted by Faridi and El-Sayegh (2016). These include not having enough skilled workers, using the wrong materials, poor supervision and management at the site, ineffective leadership, not enough or old equipment, conflicts, bad quality of work, and unqualified contractors (Anyanwu, 2023; Kolo & Ibrahim, 2020; Hanson et al., 2013).

Everyone agrees that saving money is good while getting more for what is spent. Construction firms will always want to use their investment money wisely, building more things for less cost, being more efficient, and reducing their reliance on buildings and machines that use much energy. These benefits are important to notice now and to continue working on in the future (Mehta et al., 2020).

Value engineering (VE) is a method used to make products and services better and more valuable by looking closely at how they work. Value is the relationship between what something does and how much it costs. Value can be increased by making something work better or lowering its cost (Mehta et al., 2020). The main idea of value engineering is to keep the essential functions the same and not make them less effective while trying to improve value.

Value engineering is a well-known management method that helps find the best balance between a product or project's cost, reliability, and performance. The program aims to help people manage better and make positive changes by eliminating extra costs. Usually, the value engineering team does a Pareto analysis before starting their work. This analysis helps them find the activities that need the team's attention.

VE has become a common way of doing things for many government agencies and private engineering companies since it was first used in the 1950s. Value Engineering (VE) has been commonly used in the construction industry for a long time and is an important part of many construction projects. For the past fifty years, VE has been used to come up with new ideas and solutions that improve the value of projects.

For many years, different countries in Europe and North America have used VE to improve highway projects. At first, it was used during building projects as Value Engineering Change Proposals (VECP) to lower the total construction costs. Many transportation agencies in these countries now see

better results if they use value engineering (VE) earlier when working on a project (Abu & Ahmed, 2018). VE can help define what a project will include, aid in making good decisions, and improve the quality of the project.

Many organizations in various countries understand the importance of wisely using limited resources and funds while offering good transportation services. It is expected that having a good VE program will bring more benefits besides saving money and improving designs. For instance, it will help keep standards and policies up to date, make it easier to use new materials and construction methods, boost employee excitement by involving them in decisions, and improve skills through teamwork (WVDT, 2024).

This research aims to examine how value engineering is used in heavy highway construction to enhance cost efficiency and project delivery. To achieve this aim, we need to look at these objectives:

1. To find out the benefits of value engineering application to heavy highway construction projects and
2. To identify the factors hindering the use of value engineering in construction projects.

2. Literature Review

2.1 Value Engineering in Construction

Construction projects are getting bigger and broader because of new technology. Construction companies often have to finish projects for less money while keeping the design good. Engineers seek ways to reduce building costs while maintaining good quality and performance. However, they mainly rely on what they have learned from past experiences. To stay competitive, it has been common to reduce costs by using old methods. Everyone encourages saving money while also offering more value. Value Engineering (VE) is a way to get the best results for your money. As science and technology improved, it got easier to reduce building costs. However, people did not pay enough attention to how well infrastructure worked and did not think much about how long it would last or how reliable they were. Engineers are starting to take important factors like reliability, durability, and usefulness into account to help lower infrastructure costs.

Amruta (2014) described Value Engineering as a careful and creative way to help clients save money without affecting a project's main functions or performance. Kelly, Male, and Graham (2024) say value engineering is a way to find and remove extra costs while designing and building something. They also said that Value Engineering is a way to identify the benefits a client needs from a project or part of it while keeping costs reasonable during the design and building stages.

The Department of Civil Defense (2016) describes Value Engineering as a clear and organized way to solve problems. It focuses on how systems, tools, buildings, services, and supplies work. The goal is to achieve their important tasks at the lowest total cost while maintaining needed performance, reliability, quality, and safety.

Galipogullari (2023) said that using the VE process to solve a problem usually makes things work better, last longer, be of higher quality, or have other good features (Alyousefi, 2021). They said there should be a clear reason for change and a real chance to make money to justify the extra cost of doing value engineering. Some people criticize this approach because there might be confusion.

When we talk about "getting rid of unnecessary costs," it can be misunderstood as "cutting costs." Dallas (2016) pointed out that this could lead to problems because it ignores the important roles of parts, which can mean losing features when costs are cut. The goal of Value Engineering is to be "cost-effective" (Farahmandazad, 2015).

Value Engineering (VE) is a careful method used to determine what a product or service does, determine how much that function is worth, and deliver that function reliably while spending the least amount of money possible. It relates to the cheapest way to complete a project or building work while still keeping good quality in civil engineering. Engineers usually create project plans, and then builders make them happen. Deodhar (2020) says that an engineer's job is to create an affordable project with good results. The contractor's job is to use their skills to build the project within the estimated budget, or even cheaper if they can, but always aiming to provide good value for the money spent.

The history of building highways shows many examples where new ideas have helped to make highway travel better and more efficient. Due to higher prices and job loss, we needed to create a chance to motivate people. VE was described as a tool that can cause things to occur. It is a way for engineers to encourage the creation and use of good ideas. Value Engineering is based on the idea that people spend money to achieve certain purposes rather than just to own things. Today, taking care of our environment, energy use, and rising costs is important. We must look closely at how to safely and efficiently manage cars and people walking. This will help us cost-effectively achieve these goals while causing the least harm to the environment.

Value Engineering might suggest spending more money at the start of a project if it saves money in the long run. Through saving energy and taking care of it throughout the project's life. So, it focuses on the total cost of a project over its entire life. So, Value Engineering is not just about reducing costs; it is about finding and removing extra expenses while designing and building something. This shows that we need to take a big-picture approach so the project's main goals are not affected. It is very likely that the price of one part can go up.

2.2 Benefits/Importance of Value Engineering

Using value engineering offers significant advantages for encouraging sustainable building practices. The methods of value engineering can help achieve good quality while keeping costs low throughout the entire life of a project. Al-Yami and Price (2016) and Mansour (2023) studied how value engineering is used in building bridges in Egypt. The result showed that value engineering is important and suggested using this method for bridges and other construction projects.

Khaled and Pandey (2016) say that not having support from management is not the main reason why value engineering (VE) is not used much in construction. Senior management needs to understand the advantages of using value engineering before it can be used more widely. People who manage design need to recognize the differences between what designers want and what managers want. They also need to know the tools that can help manage the building process. The choices made at the beginning of a project impact everything about it, but the industry spends the least amount of money during this early stage compared to other fields.

The value engineering process has helped improve decision-making, communication, trust, and overall satisfaction among construction industry members (Perpetua, 2019). In the end, value engineering helps organizations in the construction industry understand and adopt a culture that focuses on value. This culture of valuing people will help ensure that the construction industry works to meet the needs and expectations of clients and other stakeholders involved in the process. This will help make the construction industry work better and do a good job overall.

Senay Atabay and Niyazi Galipogullari (2023) pointed out these benefits of using value engineering in construction projects:

1. Lowering building costs
2. Completing the task early.
3. Improving and fixing quality Sure.
4. Minimizing errors and problems in project drawings.

When these benefits are achieved, the project will be more valuable, and clients will be happier, which will please the investors in the construction industry. According to Oke and Ogunsemi (2021), here are the benefits of using value engineering in construction projects:

- Encourages the use of local materials
- Supports new building techniques and ideas
- Saves money
- Helps complete projects on time
- Helps resolve conflicts
- Improves work quality
- Allows for changes and flexibility
- Gives clients good value for their money
- Helps contractors compete better
- Increases the quality of construction projects
- Removes unnecessary designs
- Improves the quality of usable space in projects
- Boosts economic investment
- Lowers costs and increases value.

2.3 Value Engineering Process

VE is a method for solving problems that focuses on improving the usefulness of a system by analyzing its functions. Value is determined by comparing how well something works to how much it costs. We can increase value by making it work better or by reducing its cost. A team of people with different skills and experiences usually does the VE study (Mahmoud et al., 2024). First, the VE team uses a "how and why" questioning method to determine how different system parts are connected. The VE team makes a chart that shows the system's different functions and how much they cost.

Finding a good balance between the different functions and their costs increases the system's overall value. The purpose of the VE study in construction is to achieve what is needed while spending the least amount of money on the project's entire life. This can be done by using new materials, clever building techniques, easier construction steps, lower costs and time, better quality and safety, and being kinder to the environment.

As Yung and Yip (2020) explain, value engineering looks at how well a project meets its goals. It aims to get the job done effectively while spending the least amount of money over its entire life. This way, it hopes to provide the best overall advantages. The simple way to say it is:

$$Vi = \frac{Fi}{Ci} \qquad Vi = \frac{\text{What you get (want)}}{\text{What you pay}}$$

Where:

Vi = value index of the i scheme,

Fi = the function coefficient of the i scheme, also termed as what you get (want);

Ci = cost coefficient of the i scheme, also termed as what you pay.

2.4 The Value Engineering Job Plan

The value engineering process (VE) follows a plan with several connected steps. The VE job plan starts with gathering information, then moves to analyzing functions, coming up with creative ideas, evaluating those ideas, developing them further, and finally ends with presenting the results, as shown in Figure 1. It is important to follow the order of steps in the VE study because they depend on each other. Each step relies on the one before it, so it is important to do them in the right order. Each phase goes through a series of steps that must be followed during the value engineering study (Abdelalim, 2018). Also, the information collected in the first step is very important for the next steps and helps finish the study. Using VE improves the quality, performance, safety, and durability of the project (Abd-Elhamed et al., 2020).

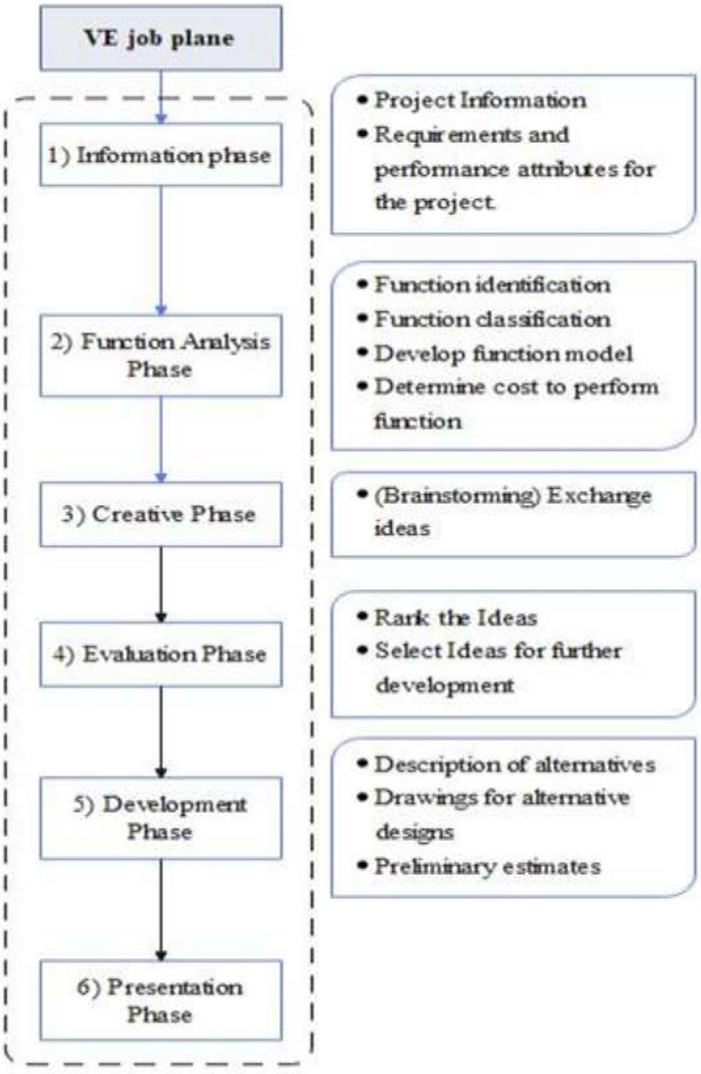

Figure 1: Value engineering job plan.

The value methodology is a step-by-step process that uses the Job Plan. A value methodology is used by a group of experts from different fields to make a project better by looking closely at what each part of it does. The Job Plan has the following steps:

1. Information Phase

The Value Engineering process begins by analyzing each stage of a project's life to determine its costs. This includes all expenses incurred in making, maintaining, and delivering the project.

Costs are divided into categories to initiate the process, such as material costs and process costs. Process costs encompass all expenditures from project creation and testing to final delivery. In Value Engineering, every aspect is subject to evaluation, from sourcing materials to project delivery. This approach enables the identification and implementation of cost-saving opportunities across various stages (Mahmoud et al., 2024).

Pareto analysis is utilized to identify the different components contributing to the total project cost.

2. Function Analysis Step

The Value Study Team describes the project tasks using pairs of action words and measurable nouns. The team looks at these functions to see which ones need to be better, removed, or created to reach the project's goals.

3. Creating Ideas

This is the stage where Value Engineering (VE) teams conduct workshops to generate innovative ideas and strategies for developing and delivering the project. Since the project may not have been reviewed for a considerable time, many of the existing methods and materials could be outdated, inefficient, or obsolete. The objective is to explore and identify the most effective approaches (Alketbi, 2020).

A multidisciplinary team should examine the function of each cost component within the project. Function analyses should focus on understanding the purpose and benefits each element provides to the customer, rather than solely assessing how it currently operates.

At this stage, the team has the opportunity to completely rethink the project's design or functionality, provided that the modifications maintain or enhance its value for the end users.

A Value Engineering process may propose the following types of changes:

- Replacing materials and components with higher-quality, more efficient alternatives that add greater value to the project.
- Eliminating unnecessary features that do not contribute to customer satisfaction or project performance.
- Integrating existing features and components to improve overall efficiency.
- Enhancing construction processes by optimizing assembly sequences or leveraging external expertise where necessary.

Right now, there are no bad ideas. Every thought and option is considered and added to a list of possible ideas.

4. Evaluation Stage

During the evaluation stage, the strengths and weaknesses of each considered idea are documented. If the drawbacks outweigh the benefits, selecting an alternative option with greater advantages is recommended. The team typically employs a method to compare and rank various options, subsequently selecting the most viable ones for further examination in the next phase (Mahmoud et al., 2024).

5. Development Stage

Here, we will explore the best ideas from the creative workshops in more detail. This part of the process involves:

- In-depth explanation of selected ideas
- Descriptions, drawings, and cost estimates
- Calculating return on investment (ROI)
- Making the project plan.

It is essential to ensure a strong justification for potential cost savings. The new design proposals should be well-founded, and the cost-saving calculations should be robust.

For instance, the time required to recover the one-time engineering costs of the proposed ideas should be carefully considered. If an investment of £10,000 results in annual savings of £1,000 over the next five years, it may not represent a viable business decision.

6. Presentation Phase

The Value Engineering (VE) leader is responsible for presenting the proposed ideas to the board for approval.

It is essential to prepare a comprehensive presentation and report for the board, ensuring that:

- Multiple options are provided for consideration.
- The ideas are supported by relevant and significant data.

- Project schedules or implementation plans are included.

At this stage, the board should have all the necessary information to approve the recommendations. They may choose to modify or incorporate additional suggestions before finalizing their decision. Proper preparation for this meeting is crucial, as a lack of readiness could delay the implementation process (Mahmoud et al., 224).

2.5 Factors Hindering the Application of Value Engineering

Odeyinka (2016) explained that value engineering is a process that helps get the most value out of a project. It involves carefully managing the project from the initial idea all the way to its completion. During this process, all decisions are checked to ensure they align with the client's values and goals. Value management is a process that looks at how projects work from the start to the end. It is done in an organized way and involves different fields of expertise. The goal is to ensure the project gives the best value and return on investment while keeping costs as low as possible throughout its entire life.

Many researchers and professionals are interested in studying how value engineering is used in the construction industry. Shen (1997) surveyed to find out how aware people were of value engineering in Hong Kong's construction industry. He found three main reasons why value engineering was not being used: people did not know enough about how to use it, they were not confident talking to clients about it, and they did not have enough time to put it into practice. He learned that the few applications are likely due to senior managers in client companies not knowing much about value engineering. Not having enough time to use value engineering and not knowing much about it are two main reasons that stop value engineering from being used in Southeast Asia (Cheah & Ting, 2015). Lai (2016) found ten reasons that make it hard to use value engineering in the construction industry in Malaysia. The main reasons are not knowing enough about value engineering, not getting support from important people like the government and owners, and not having local guidelines for using value engineering. Unsurprisingly, not knowing enough about value engineering is still a big issue. However, having little time to use value engineering is not a major problem in Malaysia. A study by Li and Ma (2022) in China found that not having enough time to apply value engineering is not a big issue.

The main problems come from not having enough knowledge about value engineering, not having technical rules and standards, and insufficient experts in value management. Many other countries, especially developing ones, have paid much attention to problems with value engineering. Perera and Karunasena (2024) found that using value engineering in construction companies in Sri Lanka is quite new, and there is not much proof of its use in the building industry. Value engineering is not used because there is no standard way to apply it, there is not enough support or advice from industry leaders to encourage its use, and people might not know about its benefits.

Recently, Aduze (2014) studied the opportunities and difficulties of value engineering in construction projects. The study found that problems like no government rules, clients not liking the idea, and people not knowing enough about value engineering are preventing its use. The study found that people in Saudi Arabia and Iran do not know much about value engineering, but this is not the biggest problem there, unlike in Hong Kong, Malaysia, and China.

Malla (2023) suggested ways to encourage the use of value engineering in the construction industry in Nepal. These suggestions include adding an incentive for value engineering proposals in contracts, getting support from top managers, creating a team with experienced members, and giving enough time to implement value engineering. Another study was done on infrastructure projects by Whyte and Cammarano (2022). They used a kind of interview with some set questions to examine how much value engineering is being applied in the engineering industry in Western Australia. The study showed that having little time, not understanding things well, and not having enough people on the team can hurt the success of the value engineering workshop. Oke and Ogunsemi (2021) looked at value engineering in building projects and found that several main problems make it hard to use value management in these projects. These problems include unclear designs, delays in finishing the work, handling conflicts, financial issues, how the work is done, not knowing the benefits of value management, and not involving professional workers.

Each of the studies mentioned above found different reasons for the problems. Most studies showed that not knowing much about value engineering is one of the biggest reasons it is not used more in the construction industry.

3. Methodology

The study is an exploratory research that includes 200 construction experts in Missouri, such as civil engineers, transportation planners, quantity surveyors, and project managers. These professionals were chosen because they have extensive knowledge of highway construction and can provide reliable information on the subject being studied.

We used a method called data triangulation to gather information. This involved using a structured questionnaire and studying selected highway construction projects in Missouri. Using Taro Yamane's formula from 1967, we distributed a total of 171 structured questionnaires on purpose. The completed questionnaires were returned, and we analyzed the data using the relative importance index to rank the responses. We also examined how strongly the ranked items were related using Spearman's rank correlation coefficient.

4. Results and Discussion

Question 1: What are the benefits of value engineering application to heavy construction projects?

The researcher asked people about the benefits of using value engineering in building projects in Missouri. This is to determine if value engineering is reaching its goals when used in construction projects.

Table 4.1: Benefits of value engineering application to heavy construction projects

		Level of Benefits								
		V/L	**L**	**H**	**V/H**	**Total Respondents**	**W/Total**	**RII**	**Mean**	**Rank**
1.	Design improvement	15	10	10	98	133	457	0.85902256	3.43609	6
2.	Improved functionality	2	9	9	113	133	499	0.93796992	3.75188	3
3.	Cost effectiveness		3	6	124	133	520	0.97744361	3.90977	1
4.	Remove unnecessary cost	2	7	7	117	133	505	0.94924812	3.79699	2
5.	To achieve innovative design	4	16	6	107	133	482	0.90601504	3.62406	5
6.	Improved lifecycle cost maintenance		14	9	110	133	495	0.93045113	3.7218	4

Source: Field Data, 2025

Table 4.1 represents the relative importance index for the four groups of respondents on the benefits of value engineering application in highway construction projects in Missouri. The table shows that the primary benefit of value engineering is achieving cost-effectiveness, with a mean of 3.91. This is followed by the removal of unnecessary costs with a mean of 3.79, improvement in functionality with a mean of 3.75, enhanced life cycle cost maintenance with a mean of 3.72, achieving innovative design with a mean of 3.62, and finally, design improvement with a mean of 3.43. This strongly supports the idea that the core benefit of value engineering in highway construction projects is achieving cost-effectiveness.

Question 2: What factors hinder the use of value engineering in construction projects?

Table 4.1: Factors hindering the use of value engineering in construction projects

The study identified 16 factors hindering the application of value engineering to building projects, which will enable us to achieve objective two of the study. Factors were extracted from the literature review, and the respondents were required to rate their responses using a 5 Likert scale.

			Level of Benefits								
		V/L	**L**	**M**	**H**	**V/H**	**Total Respondents**	**W/Total**	**RII**	**Mean**	**Rank**
1.	Lack of knowledge about VM		2	5	3	30	40	181	0.905	4.525	7
2.	Lack of local VM guidelines as well as technical norms and standards		1	4	2	33	40	187	0.935	4.675	3
3.	Lack of investment and support policy and human resources to conduct VE construction companies		3	1	5	31	40	184	0.92	4.6	6
4.	Lack of legislation providing for application of VM in the construction industry		2	1	7	30	40	185	0.925	4.625	5
5.	Lack of support and active participation from owners and stakeholders			4	1	35	40	191	0.955	4.775	2
6.	Lack of the collected information in the early stage		5	5	3	27	40	172	0.86	4.3	12

	causing difficulties in making ideas and alternatives										
7.	Inexperienced and incompetent contractors	2	2	2	2	32	40	180	0.9	4.5	8
8.	Lack of contract provisions on implementation of VM between owners and stakeholders	3	1	2	2	32	40	179	0.895	4.475	9
9.	Inexperienced and incompetent VM team's members	5		2	10	23	40	166	0.83	4.15	13
10.	Unqualified VM facilitator		8	5	7	20	40	159	0.795	3.975	14
11.	Lack of cooperation and interaction with the internal VM team		5	2	3	30	40	178	0.89	4.45	10
12.	Too few construction projects applied VM	5	1	4	11	19	40	158	0.79	3.95	15
13.	Lack of competence in cost estimation of VM team	3	1	18	7	11	40	142	0.71	3.55	16
14.	Defensive attitude of the original design team		2	1	6	31	40	186	0.93	4.65	4
15.	The complexity of proposed projects to apply VM	3	1	1	6	29	40	177	0.885	4.425	11
16.	Difficulties of conducting analysis and evaluation of alternatives			1	2	37	40	196	0.98	4.9	1

Source: Field Data, 2025

Table 2.1 presents the relative importance index by Quantity Surveyors on the factors that hinder the application of value engineering in highway construction projects in Missouri. From the table, it can be observed that the five most significant factors that hinder value engineering application in highway construction projects in Missouri are difficulty in conducting analysis and evaluation of alternatives, lack of support and active participation from owners and stakeholders, lack of value engineering guidelines as well as technical norms and standards, the defensive attitude of the original design team, and lack of legislation providing for the application of value engineering in the construction industry.

4.1 Case Study

Project Details Project: Heavy Highway Construction

Client: Missouri Department of Transportation

Location: Route 66, Springfield, Missouri

Project Description

1. Contract sum = $450,000.
2. Road length: 10 miles
3. 4-lane highway
4. Drainage system
5. Bridge construction
6. Asphalt pavement

The value management team needed to improve the highway construction project due to budget constraints and the need for durability and long-term efficiency. A building information model was made using Revit, an Autodesk software. This model includes the planned highway's structural, civil, and

mechanical aspects. The model was created during the design phase with help from the civil engineer, structural engineer, and quantity surveyor. Using this model, the project team was able to improve the project by reviewing different construction elements:

1. Pavement material
2. Drainage system
3. Bridge design
4. Road markings and safety features

Summary of the Review by the VE Team

1. Pavement Material Initially, asphalt was selected for the road surface. However, the value management team determined that using concrete pavement in high-traffic sections would enhance durability and reduce long-term maintenance costs.
2. Drainage System The original design included traditional concrete drainage channels. The team recommended using reinforced precast concrete culverts, which are easier to install and require less maintenance over time.
3. Bridge Design The initial design specified steel girders, but after a cost-benefit analysis, the team recommended using pre-stressed concrete girders for reduced maintenance and increased longevity.
4. Road Markings and Safety Features Originally, standard reflective paint was planned for road markings. The team suggested using thermoplastic road markings, which last longer and enhance nighttime visibility, improving overall safety.

Changes in the Cost of Suggestions

Table 4.3: Analysis of Cost Variation in Case Study

Original Contract Sum: $450,000

Element	**Quantity**	**Unit**	**Rate ($)**	**OMIT**	**ADD**
Pavement Material					
Asphalt	10 miles	Mile	40,000	400,000	
Concrete	5 miles	Mile	60,000		300,000
Drainage System					
Traditional Concrete	10 miles	Mile	8,000	80,000	
Precast Concrete	10 miles	Mile	12,000		120,000
Bridge Design					
Steel Girders	1	Lump	150,000	150,000	
Pre-stressed Concrete	1	Lump	120,000		120,000
Road Markings					
Reflective Paint	10 miles	Mile	5,000	50,000	
Thermoplastic Markings	10 miles	Mile	7,000		70,000

TOTAL OMIT: $680,000

TOTAL ADD: $590,000

NET REDUCTION IN COST: $90,000

NET CONTRACT SUM: $360,000 %

DECREASE: 20%

Table 4.3 shows that the project cost was reduced by 20%. Unlike traditional cost-cutting approaches, the value engineering team focused on optimizing materials and construction methods to achieve long-term cost savings. The adjustments made not only reduced initial construction expenses but also ensured better durability, lower maintenance costs, and improved road safety, reinforcing the importance of value engineering in highway construction projects.

Results from the Case Study

The goal of Value Engineering is to save money. Value Engineering can suggest reducing or increasing the initial construction cost of a project if it helps save money overall. The text talks about how a project is planned for its appearance, how it works, and how easy it is to take care of over time, based on examples from a study. It focuses on the total cost of the project over its life and how to make the project better. Value Engineering is not just about reducing costs; it is a way to find and remove unneeded expenses while designing and building something. This shows that we need to look at the whole project carefully to avoid losing sight of our main goals. Sometimes, the cost of one part can go up because of what is needed for construction.

4.2 Discussion

The study aimed to examine how value engineering can be applied to highway construction projects in Missouri, including its advantages and the challenges it faces. The study reviewed research on using Value Engineering in heavy highway construction projects. It also identified factors that hinder the application of these methods based on a survey analysis. Based on the data discussed, here is a summary of the findings. The study demonstrated that using value engineering for highway construction projects has advantages, including cost savings, improved project efficiency, and other benefits.

The six main challenges hindering the application of value engineering in highway construction projects in Missouri, as identified by Quantity Surveyors, Architects, Civil Engineers, and Builders, are:

1. Difficulty in analyzing and comparing different options.
2. Lack of support and involvement from owners and other stakeholders.
3. Defensive attitudes from the original design team.
4. Absence of local guidelines or standards for value management.
5. Lack of legislation promoting value management in construction.
6. Insufficient investment, support, and skilled workforce for value engineering in construction firms.

5. Conclusion

The study says that even though people in the construction industry know that Value Engineering can help construction projects, it does not work well. This is because only a few experts know how to use it, and there are not enough resources and skills to do it properly. This makes it hard to apply Value Engineering effectively, leading to less benefit because there are problems in evaluating options and managing the process of the whole project.

The quality and costs of highways and other public projects can be improved by using good value engineering methods. The VE process offers a useful way to understand the goals and features of a project. This helps to look for different options during the value study. VE can help cut down or prevent extra spending on building projects. VE can help make better decisions for highway projects, improving how well the projects work and their quality. It can also help meet project goals and consider what the community wants.

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