

Adoption of Value Engineering in the Affordable Housing Initiative - A Review

Mayankkumar M. Chaudhari¹, Dr. J. R. Pitroda², Prof. A.N. Bhavsar³

¹M.Tech. (Civil) Construction Engineering and Management, BVM Engineering College, Vallabh Vidyanagar, Gujarat, India

²Associate Professor, PG Coordinator, Construction Engineering and Management, Civil Engineering Department, BVM Engineering College, Vallabh Vidyanagar, Gujarat, India

³Associate Professor, Civil Engineering Department, BVM Engineering College, Vallabh Vidyanagar, Gujarat, India

Abstract - Indian authorities are dealing with a huge issue in the shape of urbanization, which has led to unaffordable housing and poor dense urban conditions. Each person's dream is to have their own home. One of the major issues that emerging countries face is providing affordable housing for all citizens. India is now witnessing a severe housing crisis. Of these, more than 90% shortage relates to EWS ("Economically Weaker Section") and LIG ("Low Income Groups") homes. The ideal of homeownership has become a challenging reality, particularly for low- and middle-income families. The Nation is on a strive to meet all of society's housing affordability until the year 2022. The countrywide demand for materials and energy is predicted to be high due to the construction of thousands of homes. Substitute materials, construction practices, and construction ideas must all be evaluated in order to reduce overall material and energy use. This paper explores the use of value engineering to bridge affordable housing system gaps in terms of achieving housing for all.

the LIG and EWS. We must acknowledge that persons on the LIG and EWS have equal opportunity to housing amenities. Chart-1 shows that EWS and LIG groups cannot acquire House due to the high house price-to-income ratio.

Key Words: Affordable Housing, Challenges, Construction, Government, Housing crisis, Economical Weaker Section, Low Income Group, Value Engineering

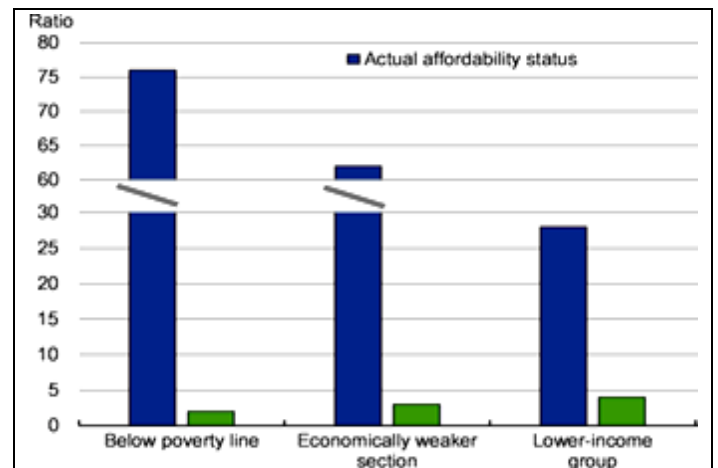


Chart -1: The proportion of a home's price to a family's annual income., 2010

1.INTRODUCTION

The shelter has become one of the 3 main necessities, along with eating and other necessities. Yet after Seventy-five years of independence, India's housing situation continues to deteriorate, specifically among the poorer classes. The rapid development of the urban population has resulted in a severe housing crisis and unacceptable metropolitan lifestyle conditions. The never-ending stream of immigrants from the countryside to the areas in search of jobs is causing urban unaffordable housing. In the 20th century, the rate of urbanization increased dramatically. Metropolitan areas have congested slums as a result of urban sprawl. Slums are home to a large percentage of the underprivileged. In India, affordability is a serious issue, especially in cities. There are significantly cheaper dwellings for them in slums, but they are incredibly unhealthy in regards to hygiene and other physical infrastructure, and there are dwellings in metropolises with all of the basic accessories, but they are beyond of reach for individuals on

Houses that fulfil the necessities of households whose budgets are insufficient to allow them to afford acceptable housing in the market are quite often referred to as affordable housing. Several efforts have been made around the world to provide inexpensive housing solutions for everyone. By 2022, the Indian government had announced the mission of 'Housing for All.' The Central Government has initiated comprehensive scheme named "Pradhan Mantri Awas Yojana - Housing for All", Mukhyamantri Awas Yojana" in order to attain this vision. The utilization of relatively economical materials, innovative building processes, ecological strategies, and other methods can help attain this affordability. The following Chart-2 Showing rising prices of affordable housing in India.

The foundation of value engineering is functional analysis, which is a technique of conceptualizing and management technology that aims to enhance property value and resource utilization. Its goal is to achieve the greatest overall benefit by reliably realizing the product's essential function

and the user's required to function at the cheapest life cycle cost.

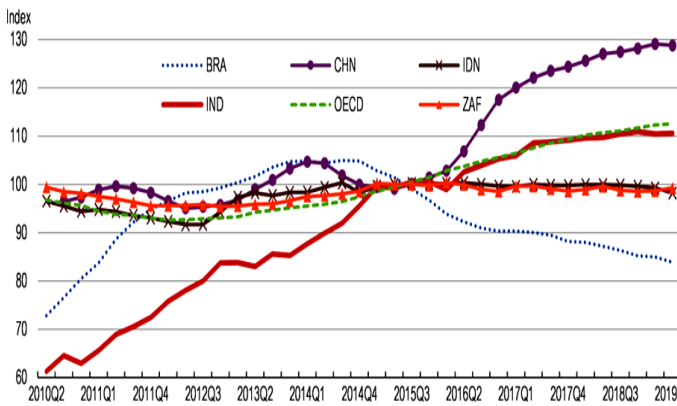


Chart -2: Housing Prices in different countries

1.1 Need of Study

1. People have been forced to live in slums with deteriorating living conditions as a result of rapid urbanization and increasing housing costs.
2. The countrywide demand for materials and energy is predicted to be high due to the construction of thousands of homes.
3. Existing affordable housing prospects in Gujarat (India) are unsatisfactory in terms of quality and sustainability, resulting in housing scarcity. To solve these challenges, a preplanning study is required.

1.1 Objective of Study

The study's objectives are to explore a variety of literature, examine the current state of affordable housing in Gujarat (India), and understand value engineering concepts in an affordable housing project for EWS and LIG participants in India.

2. UTILIZATION OF VALUE ENGINEERING IN RESEARCH

The following evaluation of the literature is centered on the use of value engineering in several constructions' multiple disciplines.

2.1 Utilization of Value Engineering in Transportation Project

Tung-Tsan Chen et al. (2011) The feasibility of doing value engineering is investigated using a VE analysis of second-round collector roadwork in Taipei port. The FDM method was utilized to pick 10 assessment elements from a total of 24 parameters referenced in the relevant literature. The

overall evaluation was analyzed using the Fuzzy Analytic Hierarchy Process. In the appraisal of value management, the Fuzzy Delphi and AHP methods can be useful. The detailed design analysis will be more possible as the project grows in size.

Rudra P. Pradhan et al. (2014) The impact of infrastructure on Economic growth and poverty reduction from 1970 to 2010 is examined. The research establishes a bidirectional relationship between the transport sector and wealth creation using the VECM ("Vector Error Correction Model"). The strengthening of road infrastructure, together with enhanced economic growth, will propel India's economy to new heights because 1) a good road helps commodities to be carried to the marketplace in much less time 2) the authority can implement a toll fee, which adds to the government's wealth 3) As the economy rises, so does people's personal income also increase. By attracting private investment, infrastructure can operate as a magnet for area economic growth, resulting in an increase in total GDP.

Renata Schneiderova Heralova (2016) Highway construction is frequently criticized for three major reasons. First, they fail to meet aims; second, they fail to deliver projects in a timely manner; and third, expenditures exceed their budgetary constraints. In transportation construction, the design stage is critical for financial control. By employing VE approaches throughout the design phase of road construction help to reduce cost and the construction timeframe, increasing the probability of return on the project. The job plan is the key for describing the necessary tasks and selecting one of the most cost-effective function combinations to perform it. Benefits of the VE job plan include: resolving technical hurdles in complicated projects, gaining extra specific capabilities, making optimal use of resources, improving project efficiency and financial savings, and increasing the value of a project by separating necessary from unneeded functions.

2.2 Impact of Value Engineering in Infrastructure Project

Mohammed Ali Berawi et al. (2014) value of infrastructure projects has a positive relationship with the economy, the study examines value creation in project development by adding new functions and evaluating the value for money of two mega infrastructure projects in Indonesia: The Sunda Strait Bridge (SSB) and the Soekarno-Hatta Rail Link (SHIARL). FAST diagram is use for idea generation tool. A questionnaire is delivered to the project's connected stakeholders both online and offline. The questionnaire survey took a month to complete, with 35 responses for SSB and 32 for SHIARL. Following the completion of the questionnaire analysis, a focus group discussion (FGD) was held to get additional feedback from various stakeholders on the findings. Finally, value for money is attained for both proposed project development

and life cycle cost analysis, which results in a positive NPV and significant IRR.

Eng. Ahmed M. Selim et al. (2017) Infrastructure creation is considered one of the most important aspects of achieving livability, according to a World Bank report from 2015. Investments were made projects will reach \$9 trillion dollars worldwide in the next five years, through 2020. described the definition of VE, its benefits, and how to put it into effect in different steps of the Job Plan (6 phase) practice. Infrastructure ventures have a unique nature in terms of scale, diversity, and huge capital costs; hence most infrastructure projects employ the BOT System since PPP has several merits such as avoiding government funding and pooling identified risk with the private sector. VE is critical in infrastructure (PPP) developments to deliver good service at an affordable cost because all these developments can be extremely expensive, and providing the necessary functionality safe manner, dependably, quickly, and at the least possible cost by removing irrelevant costs in the various project phases is critical. Value engineering of large capital projects often results in a cost reduction of at least 10%.

2.3 Utilization of Value Engineering in Indian Context

Neetu B. Yadav et al. (2013) Value engineering, as quite a productive and innovative method, This must be acknowledged at all layers of project organization Because it is more of a management activity than technical expertise, the term "value management" is now used in India rather than "value engineering". The author discusses the broad notion of VE, as well as its origins by year evolution in the Indian scenario. The relevance and critical function of the construction industry is demonstrated by India's spending in the construction field and infrastructure projects. Aside from the enormous sums involved, the construction industry has a wide range of construction projects including a big group of stakeholders, resources, planning and construction methodologies, and so on, implying a broader spectrum of value management applications. Identify the characteristics of the Construction sector, VE studies could be used to classify and find ways to overcome vulnerabilities with creative alternatives, resulting in increased productivity, financial benefits, enhanced efficiency, good performance, simpler layout, and optimum timeframe without compromising the function of any project. A small portion of the leftover cash from the construction field, which is considerable, can be converted and utilized in other areas for the country's economic overall development.

Pooja Gohil et al. (2018) Value Engineering is an organizational strategy that aims to find the optimal process improvement between a product's cost, dependability, and productivity. VE is a unique key problem-solving tool that can help companies conserve money while still delivering high

performance and reliability. As per the Indian context, Five Phase job Plan is used. It is not properly used in India, and it is frequently mistaken with the principle of cost reduction.

2.4 Utilization of Value Engineering Affordable Housing Project

A. Ganga Warriar et al. (2019) The Govt is on a goal to address everyone's housing demand by 2022. The Pradhan Mantri Awas Yojana has granted 5.1 million dwellings as of today. A large part of this project is housing for the EWS (Financially Weaker Section) and the LIG. At the national level, the construction of millions of residences is predicted to produce a considerable demand for resources and energy. To save resources and energy at the absolute level, substitute materials, constructability, and construction strategies must be evaluated. There are various low-cost housing tools available. It's difficult to select a single technology for use across the country. As a result, research should be conducted per territory to determine the most relevant technology based on situation, place, geography, locally existing resources, tenant preferences, cultural difficulties, timeframe, expense, economy, and other variables. Thermal insulation is also crucial for the effectiveness of housing designs. Passive design techniques may be beneficial in achieving heat transfer and lowering energy performance. In other circumstances, however, passive design alone is insufficient to provide the necessary living comfort. As a result, research needs to focus on climate control solutions that utilize the least amount of energy while simultaneously being cost-effective.

Jayraj Gohil et al. (2019) The Indian government faces major difficulty in dealing with the dramatic rise of urbanization, which has resulted in unaffordable housing and substandard urban-dwelling conditions. The increasing necessity for cheap housing in India is driven by a number of causes, including India's continuous urbanization, which is accompanied by a growing urban population. Research explores numerous pieces of literature in order to comprehend PMAY, a low-income housing scheme for all residents in India, particularly those from the Weaker Sections. The study highlights some of the key affordable housing programs in India and assesses the effectiveness of PMAY in providing cheap homes in the nation. The government offers everything it has to meet housing demand and supply.

Prashant Sharma et al. (2021) According to the 2011 statistics, the nation's existing housing deficit is estimated to be at 19 thousand tons. Excess cost control must be managed from the initial design stage until the project is completed. Value engineering is a problem-solving technique that reduces costs while conserving and enhancing quality and productivity standards. The first example study was presented with three choices, including employing sand blocks instead of AAC blocks. Sand blocks provided similar

or slightly better uniformity at a lower cost, and they were locally accessible material based on the site's location. The usage of paver block pavement instead of RCC road was the second option presented. It has been discovered that substituting a material with identical functionality reduces project costs while increasing the value of a project. The second example study had two options, including the use of Mivan shuttering instead of traditional shuttering. It was discovered that using Mivan shuttering cut the 52 cent reduction in construction time when compared to traditional shuttering. The second option presented was to use CLC blocks instead of 4-inch bricks because of their lightweight, which helped to reduce the building's total burden. It's been discovered that substituting a material with identical functionality reduces construction costs while increasing project quality.

Following is a list of authors who apply VE in especially for low projects, based on a series of studies. Following Table-1 shows how many researchers used value engineering in a specific affordable project.

Table -1: Implementation of Value Engineering by Authors

Sr. No	Scheme	Country	Auhors			
			Jayraj Gohil et al.	A.Ganga Warriar et al.	Prashant Sharma et al.	Laila M. Khodeir et al.
1	Pradhan Mantri Awas Yojana	India	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
2	MukhyaMantri Awas Yojana	India			<input checked="" type="checkbox"/>	
3	Affordable Mortgage Program	Egypt				<input checked="" type="checkbox"/>

3. AFFORDABLE HOUSING

Houses that satisfy the needs of a family whose incomes are insufficient to enable them to Obtain a Low-Cost Home on the marketplace are often referred to as affordable housing. Individuals, families, and the environment all have a core need for decent housing, which is universally recognized. A globally acknowledged guideline for housing affordability in the USA is that housing costs should not exceed 30% of an average household gross income. Owners' taxes and insurance, as well as utility bills, are included in housing costs. ("Vibrant Gujarat 2017"). "Housing affordability refers to any shelter that fulfills some form of affordability benchmark, which could be the family's average income, the amount of a housing unit, or accessibility in terms of EMI size or ratio of house price to yearly income," according to one of the most widely accepted interpretations of affordability accepted by the Government of India ("Affordable Housing for All, 2008"). Table-2 shows a categorization of housing projects based on the MOHUPA ("Ministry of Housing and Urban Poverty Alleviation") 2011 criteria.

Table -2: Suggestive Definition of Affordable Housing

Household Budget	Categories of people	Minimum Volume of Dwelling	Provision of Essential Services	The House's Location
EMI < 30-40% of the homeowner's monthly amount	*EWS*	*Floor area: 250 sq. ft.*	Hygiene, sufficient water supply, electricity, public parks, education, and medical centers, are provided primarily within the property	Within 20 kilometers of a large workplace
	LIG	*Floor area: 300-600 sq. ft.*		
	MIG	Floor area: 600-1,200 sq. ft.*		

3.1 Need for Affordable Housing

1. Citizens have been compelled to live in slums with degrading dwelling conditions as a result of uncontrolled urbanization and increasing land costs.
2. Accelerated urbanization is occurring in tandem with an increasingly the metropolitan population has exploded from 10.9 crores in "1971" to 32 crores in "2011", with 60 crores anticipated by "2030".
3. Space and real property limits, as well as the impact on essential services like freshwater, electricity, and sewage, are all consequences of the increased influx of population in urban environments. The Department of Building forecasted a shortage of 18.78 million low - cost houses over the 12th Scheme era, with 95 cents of them in the economically weak and lower-income sectors.
4. A focus on affordable homes would not only improve people's standard of living but will also greatly raise the country's GDP.

4			<input checked="" type="checkbox"/>	Started in 1972	Environmental Improvement of Urban Slums
5	<input checked="" type="checkbox"/>			Started in 1996	IAY (*Indira Awas Yojana*)
6			<input checked="" type="checkbox"/>	Started in 2001	VAMBAY (Valmiki Ambedkar Awas Yojana)
7			<input checked="" type="checkbox"/>	Started in 2005	Jawaharlal Nehru National Urban Renewal Mission
8	<input checked="" type="checkbox"/>			Redraft in 2012	National slum development program
9	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Started in 2009	Rajiv Awas Yojna
10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Started 2015	Pradhan Mantri Awas Yojana - Urban

3.2 Government role in Affordable Housing

The Indian government took the first measures in the 1980s and 1990s. After independence, the unavailability of dwellings in the nation has expanded tremendously. As a result, in 2004, the Indian government established the Ministry of Housing and Urban Poverty Alleviation to address housing requirements as well as programs aimed at enhancing metropolitan quality. This ministry has been engaged in a range of schemes and initiatives pertaining to accommodation, employment levels, transit, healthcare, and sanitation since its beginnings. Since independence, the Indian government has implemented many housing initiatives, as seen in Table-3 below

Table -3: The India government launched a number of public housing initiatives

Sr No	Specific Group			Put in Place	Government Scheme
	EWS	LIG	Urban Slum		
1	<input checked="" type="checkbox"/>			Started in 1952	Integrated Subsidized Housing Scheme for Industrial workers and Economically Weaker Sections
2	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Started in 1954	Low Income Group Housing Scheme
3	<input checked="" type="checkbox"/>			Started in 1959	Village Housing Projects Scheme

4.VALUE ENGINEERING

Value engineering is a method of assessing an item's utility in order to improve its worth without sacrificing its quality, effectiveness, or efficiency. It's a methodical approach to get the most value for the money at the cheapest cost while maintaining the requisite level of quality and functionality. The worth, purpose and life-cycle costs are the three main parts of a value project

$$\text{Value} = \frac{\text{Function}(F) + \text{Quality} (Q)}{\text{Cost} (C) + \text{Time} (T)}$$

As Per the equation mentioned, we can increase the value of construction items in following two ways

1. Improve the Project's F and Q while keeping T and C the same
2. Reduce T and C input without affecting F and Q

Value Analysis can be used at any step of the project development process, although the best results are obtained early in the process, during the design phase as shown in Fig-1

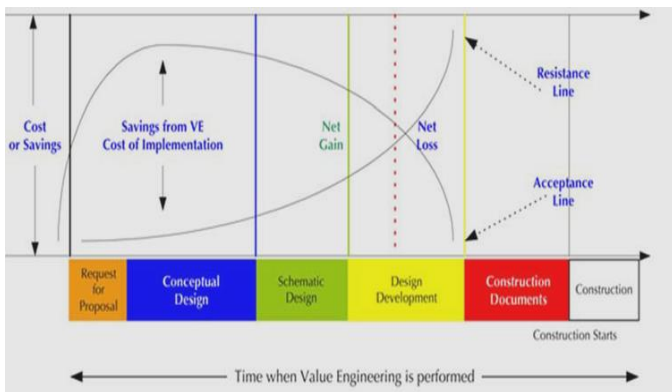


Fig -1: The project's stages and their relationship to SAVE International's predicted savings

5	Development Phase	Choose and organize the "correct" value improvement alternative(s)
6	Presentation Phase	Present the findings of the investigation to a top executive

Fig-2. depicts the entire value engineering job planning process.

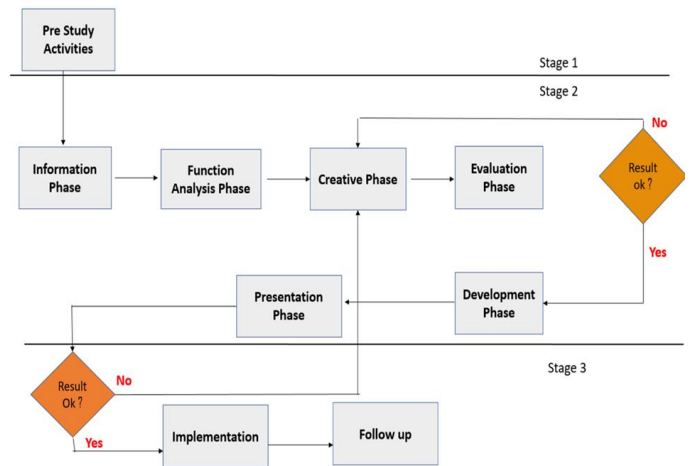


Fig -2: Value engineering job planning process

4.1 Value Engineering Job plan

A job plan is a process of Value Management that is well-organized and rational. It assists in identifying critical areas of wasteful spending and looks out for new and innovative ways to accomplish the same purpose as the actual part, procedure, or resource. There are various job plans that can be selected based on the project's feasibility and specifications, including Five Phase (Standard), Six Phase, Seven Phase, and Eight Phase Job Plan. Major responsibilities of each phase are shown in table-4.

Table -4: The India government launched a number of public housing initiatives

Sr No	Job Plan Phase	Aim
1	Information Phase	Obtaining background information, reviewing client expectations and demands, developing aims and targets, way to implement, and understanding actual prices, including cost model
2	Function Analysis Phase	To distinguish between primary and secondary functions
3	Creative Phase	To Generate a lot of creative ideas to meet the study's objectives
4	Evaluation Phase	During the review process, the glaring ridiculous ideas developed during creative activities will be eliminated, the ideas will be organized into clustering, then reviewed in accordance with project criteria, and the best combination of ideas will be discovered

4.2 Tangible Benefits of Value Engineering

The Following Fig-3 depicts the tangible benefits of VE

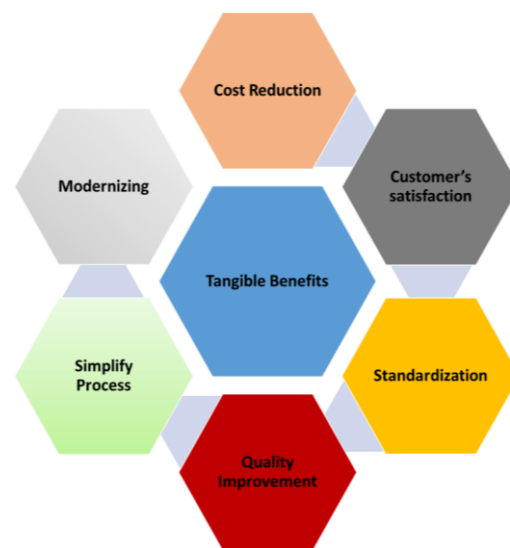


Fig -2: Tangible benefits of VE

5. CONCLUSIONS

Due to the sheer tremendous development of the metro community, the demand for affordable housing is increasing rapidly, and government-sponsored alternatives, such as housing schemes, cost a significant amount of money. This becomes vital to apply new construction strategies such as Value Management in complex projects, where expense, profitability, workmanship, and timescale all play a big part.

The quality of affordable accommodation is poor due to the use of low-quality materials, a lack of oversight, and a lack of thorough research of readily sourced materials and procedures, among other factors. Based on this, a technology solution to increase the quality of affordable housing developments must be developed. According to current housing crisis statistics and the rate of housing supply additions in the nation, the current housing scarcity is only projected to worsen in the coming years.

Job Plan is a powerful method for finding and eliminating waste in construction initiatives, resulting in long-term value creation. It has well-known merits, but it is not implemented properly and is tangled up with the philosophy of cost-cutting rather than value enhancement.

This paper finishes with an explanation of how Value Engineering works and the advantages of using it in the Affordable Housing Project of the construction industry

REFERENCES

- [1] "Housing shortage in urban areas down at 10 million units: Government - The Economic Times." <https://economictimes.indiatimes.com/wealth/personal-finance-news/housing-shortage-in-urban-areas-down-at-10-million-units-government/articleshow/61657624.cms?from=mdr> (accessed Jan. 12, 2022).
- [2] É. É. Revenue, "Ministry of Housing and Urban Poverty Alleviation," no. 55, pp. 2008–2008, 2008.
- [3] P. Tiwari and J. Rao, *Housing Markets and Housing Policies in India*, no. 565. 2016.
- [4] "Study Report: Ministry of Housing and Urban Affairs, Government of India." <https://mohua.gov.in/cms/report.php> (accessed Jan. 12, 2022).
- [5] K. County and F. Chia, "Assessment of Value Engineering Applied to the Study of Transportation Infrastructure - An example of the construction of second round collector roads in Taipei Harbor Tung-Tsan Chen 1 , Yao T. Hsu 2," no. 223, pp. 160–169, 2011.
- [6] R. P. Pradhan and T. P. Bagchi, "Effect of transportation infrastructure on economic growth in India: The VECM approach," *Res. Transp. Econ.*, vol. 38, no. 1, pp. 139–148, 2013, doi: 10.1016/j.retrec.2012.05.008.
- [7] R. S. Heralova, "Possibility of Using Value Engineering in Highway Projects," *Procedia Eng.*, vol. 164, no. June, pp. 362–367, 2016, doi: 10.1016/j.proeng.2016.11.631.
- [8] V. Shahhosseini, M. R. Afshar, and O. Amiri, "Value engineering practices in infrastructure projects : a case study of Ilam Gas Refinery ' s water transmission system at Reno Mountain , Iran," *Int. J. Constr. Manag.*, vol. 0, no. 0, pp. 1–13, 2017, doi: 10.1080/15623599.2017.1326298.
- [9] E. A. M. Selim, O. Abd, and P. M. R. Hagag, "Value Engineering (VE) Application in Infrastructure Projects by Public- Private Partnerships (PPPs)," vol. 12, no. 20, pp. 10367–10375, 2017.
- [10] "A review on value engineering techniques in indian context," vol. 3, no. 5, pp. 1–8, 2013.
- [11] P. Gohil and S. Patel, "Review of Value Engineering in Indian Construction Industry .," vol. 8, no. Iii, pp. 1080–1085, 2018.
- [12] A. Ganga Warriar, P. Tadepalli, and S. Palaniappan, "Low-Cost Housing in India: A Review," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 294, no. 1, 2019, doi: 10.1088/1755-1315/294/1/012092.
- [13] I. Journal, "IRJET- Pradhan Mantri Awas Yojana (PMAY) Scheme -An Emerging Prospect of Affordable Housing In India," 2018.
- [14] P. Sharma and R. Srikonda, "Application of Value Engineering in Affordable Housing in India," *Int. J. Eng. Technol. Manag. Res.*, vol. 8, no. 2, pp. 29–40, 2021, doi: 10.29121/ijetmr.v8.i2.2021.865.
- [15] G. Lin, G. Q. Shen, M. Sun, and J. Kelly, "Identification of Key Performance Indicators for Measuring the Performance of Value Management Studies in Construction," *J. Constr. Eng. Manag.*, vol. 137, no. 9, pp. 698–706, 2011, doi: 10.1061/(asce)co.1943-7862.0000348.
- [16] E. Science, "Value engineering application in a high rise building (a case study in Bali) Value engineering application in a high rise building (a case study in Bali)," 2018, doi: 10.1088/1755-1315/195/1/012015.

- [17] W. Tong, P. Chang, and Y. Huang, "Assessing the overall performance of value engineering workshops for construction projects," *Int. J. Proj. Manag.*, vol. 28, no. 5, pp. 514–527, 2010, doi: 10.1016/j.ijproman.2009.08.005.
- [18] I. O. P. C. Series and M. Science, "Value management / value engineering (VM / VE) application in Malaysian public construction projects : application of VM / VE study improved roads project sustainability Value management / value engineering (VM / VE) application in Malaysian public co," 2019, doi: 10.1088/1757-899X/512/1/012046.
- [19] A. Jaapar, N. Amani, and M. Zawawi, "Implementation of Value Management in Public Projects," *Procedia - Soc. Behav. Sci.*, vol. 68, pp. 77–86, 2012, doi: 10.1016/j.sbspro.2012.12.208.
- [20] K. Miladi and O. A. Yamini, "The Methodology of Using Value Engineering in Construction Projects Management," 2016.