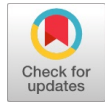


Application of Management Techniques in Controlling Cost Overruns in Residential Construction Projects



Shrirang T Kulkarni, Kranti Kumar M

Abstract: Construction projects in developing countries are frequently plagued by cost overruns. These overruns, which refer to the additional costs incurred beyond the initially estimated budget, are a common occurrence in the construction industry. The extent of these cost overruns varies significantly from one project to another, thereby necessitating a comprehensive investigation into the factors contributing to such discrepancies. The cost of construction plays a pivotal role in determining the success of a project throughout its lifespan. Thus, it becomes imperative to scrutinize the disparity between the actual cost of building projects and the initially projected cost, which typically ranges between 20% and 50%. Given the prominence and impact of cost overruns in residential buildings, it is crucial to address this issue promptly and effectively. Consequently, the primary objective of the present research is to thoroughly examine the role of Management techniques in mitigating cost overruns and identify the most efficient technique that can be employed in controlling such overruns, with a specific focus on Residential Projects in India. Through this investigation, valuable insights can be gained, which can contribute to the development of strategies and approaches that effectively manage cost overruns in the residential construction sector. The current study delves into the exploration of the application of various Management techniques in effectively controlling cost overruns specifically in the realm of residential construction projects.

Keywords: Cost Overruns, Cost Management, Construction Industry, Cost Control

Aim:

The research aims to explore the various management techniques and identify the most effective method for preventing cost overruns in residential building projects.

Objectives:

1. Understanding the current state of cost overruns in residential construction projects.
2. To examine the principles and methodologies used to overcome the cost overruns.
3. Understanding the Impacts and Causes due to cost overruns and applying the management techniques to mitigate it.

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I. INTRODUCTION

Construction industries play a significant role in advancing a nation's economic growth. The construction sector has emerged as one of the most crucial global enterprises in recent times. The construction sector in India is the second largest employment generator, currently providing jobs to approximately 71 million individuals, and this number is projected to surpass 100 million by the year 2030, as stated in the Knight Frank-RICS report. The complexity of construction projects is increasing, thereby exerting greater pressure on construction managers to complete projects within the designated timeframe, while adhering to budgetary constraints and achieving a superior level of quality. Clients' expectations are steadily escalating as they seek to obtain a premium product. One of the primary obstacles faced by the construction industry is cost overruns, and to surmount this challenge, it is imperative to accurately identify the root causes that have contributed to the industry's present predicaments. The popularly understood description of "Project Cost" is the fiscal sum needed to complete the product of construction-related particulars, similar to structures. In general, the cost of a design is calculated by quantitative estimates of the estimated total quantum of coffers demanded to complete all essential operations; labor, accouterments, inventories, and so on. Hence, the cost of the design corresponds to the amount of cash required for completing all the necessary procedures associated with this specific design. Subsequently, the cost overrun can be easily approximated by dividing the alteration in the contractual amount by the initial amount awarded in the contract. Therefore, the cost overrun can be expressed as the difference between the final actual cost and the initially estimated budget cost (Cost Overrun = Final Factual Cost-Original Estimated Budget Cost) [6]. It can also be defined as the surplus of the actual cost compared to the budgeted cost. Moreover, cost overrun is also known as cost escalation, cost increase, or budget overrun.

Value Management (VM) originated in the United States during World War II due to material shortages, with Lawrence Miles founding the concept in 1942. Since then, it has become widely used across industries. In Indian residential projects, common factors contributing to cost overruns include inadequate site management, subpar scheduling, limited contractor experience, poor communication, and improper contract terms. Cost overruns, when the actual cost exceeds the planned cost, are prevalent in domestic construction systems [8].

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Value operations, a process involving analyzing and optimizing design value, can play a crucial role in controlling cost overruns by identifying areas for cost reduction without sacrificing quality. This research aims to study how value management can reduce cost overruns in residential projects, examining causes and effects, evaluating case studies, and addressing challenges. Involving all stakeholders and understanding project objectives are essential for effective value management implementation, with the study providing valuable insights for optimizing project outcomes in the residential building sector.

II. METHODOLOGY

Literature review, which explains the role of value management and the main phases of the VM approach. Analysis of examples and application of (VM) on these examples which explain the cost reduction after and before applying (VM) phases in residential projects. Application of a questionnaire survey to find the level of awareness of (VM) and the impact of (VM) on residential project quality and cost according to respondent's answers.

III. LITERATURE REVIEW

To achieve the objectives and aim of the study it is very important to undergo a thorough literature review that deals with cost overruns.

A. Defining Cost Overruns:

When the project's actual costs end up being more than anticipated, this is referred to as a "cost overrun." Cost has unquestionably been shown to be a crucial element in achieving any project's success as well as one of the most important aspects affecting the project's quality. "Cost" is a pivotal and profoundly influential element within the life cycle of project management, and it can be perceived as a catalyst for the triumph of the project. In addition to its

previously demonstrated significance, it is exceedingly futile to witness a project's objectives not being fulfilled within the originally allocated budget. The majority of construction project sites are characterized by fluctuations in cost from the initial design. However, inadequate measures were taken to prevent this well-established phenomenon. The subsequent portion of this investigation endeavors to meticulously examine, explore, ascertain, and assess the significance of various factors that may impact the divergence and variability in costs within residential construction projects in India.

B. Concept of Cost Overrun:

Cost overrun can happen in the context of residential projects when the project's actual cost exceeds its anticipated or budgeted cost. This may occur for several reasons, including modifications to the project's scope, unforeseen site circumstances, faults or omissions in the design, and unexpected increases in material or labor prices. Cost overruns can have significant implications for residential projects. They can result in delays, reduced quality, and increased financial risk for the project stakeholders, such as the owner, developer, and contractor. Cost overruns can also affect the affordability and availability of housing for residents, and may limit the ability of developers to deliver the expected level of amenities and services. Cost overrun, according to the Asian Development Bank's definition from 2003, is "the excess of the foreign exchange and/or local currency expenditures incurred or expected to be incurred by the borrower over and above the project cost estimates as originally approved by the board." According to Angelo and Reina (2002) [9], the issue of cost overruns is serious and requires further research to be resolved. In addition, they note that cost overruns are a significant issue in both wealthy and developing nations [3].

C. Identifying different Management Techniques:

Table 1: Different types of Cost Control Techniques

Cost Control Technique	Description
Risk Assessment	Identify potential risks and uncertainties, develop contingency plans, and allocate a budget.
Regular Budget Monitoring	Continuously monitor project expenses against the budget using construction management software or tools.
Change Order Management	Implement a strict change order process, document, review, and approve changes to the project scope.
Quality Control	Maintain high construction quality to prevent costly rework and repairs through quality checks and inspections.
Value Engineering	Continuously evaluate materials and design to identify potential cost savings without compromising quality.
Effective Communication	Establish open and effective communication channels among the project team to promptly report potential issues.
Value Management	A systematic approach to determine and enhance an organization's or project's value while lowering costs and risks.

Table 2: Comparison of Cost Control Techniques

Cost Control Technique	Key Features	Strengths
Risk Assessment	Identifies and mitigates potential risks.	Prevents unforeseen costs.
Regular Budget Monitoring	Tracks and reviews financial performance.	Timely adjustments to prevent overruns.
Change Order Management	Manages modifications to the project scope.	Prevents budget overruns; aligns with goals.
Quality control	Ensures products/services meet predefined standards.	Reduces defects and rework costs.
Value Engineering	Optimizes value by analyzing functions/ components.	Reduces costs without compromising quality.
Effective Communication	Fosters clear and transparent communication.	Prevents misunderstandings and errors.
Value Management	A comprehensive approach integrating various techniques.	Optimizes overall value's long-term focus.

- Risk assessment involves identifying, analyzing, and mitigating potential threats to a business's financial health and operational stability. By proactively addressing risks such as market fluctuations or supply chain disruptions, organizations can safeguard against unforeseen costs and ensure long-term financial sustainability.
- Regular budget monitoring entails continuously tracking financial performance against set budgets to detect variances and promptly make adjustments. This promotes transparency, accountability, and proactive cost management, ensuring organizations adhere to fiscal objectives.
- Change order management handles modifications to a project's scope through a structured approval process. By effectively managing change orders, organizations can prevent budget overruns and ensure that modifications align with project objectives, enhancing efficiency and controlling costs.
- Quality control ensures that products or services meet predefined standards, minimizing costs associated with defects and customer dissatisfaction. By emphasizing quality assurance processes, organizations can reduce waste, improve efficiency, and foster customer loyalty.
- Value engineering optimizes the value of products or projects by analyzing functions and components to achieve desired performance at the lowest possible cost. This technique identifies opportunities for cost reduction without compromising quality, maximizing cost savings and value.
- Effective communication fosters collaboration, minimizes errors, and promotes efficiency within an

organization. By ensuring clear and transparent communication among team members and stakeholders, organizations can prevent costly mistakes and delays, empowering employees to contribute to cost control efforts.

Why Value Management is Considered Comprehensive:

Holistic Approach: Value Management encompasses elements of risk assessment, budget monitoring, change order management, quality control, value engineering, and effective communication. It integrates these techniques for a more comprehensive approach.

Long-Term Focus: While other techniques address specific aspects, Value Management takes a more strategic and long-term perspective, emphasizing continuous evaluation and improvement throughout the project lifecycle.

Optimization of Value: Value Management goes beyond cost reduction; it seeks to optimize overall value, ensuring that resources are allocated efficiently and that the desired outcomes are achieved.

Flexibility and Innovation: Value Management encourages innovation and flexibility, allowing organizations to adapt to changing circumstances and technological advancements, which can result in sustainable cost savings. While each technique has its merits, Value Management is considered superior for its ability to provide a well-rounded and forward-looking framework that incorporates various cost-control strategies for sustained success. However, the choice of the most appropriate technique depends on the specific needs and circumstances of the organization.

Case Study: Project Based

Table 3: Cost Overruns in Residential Projects

Point of Comparison	Example 1	Example 2
Project Name	H-House, a luxurious residential project in Surat, Gujrat	RP Residence, Greater Noida
Factors affecting the cost overrun	Deficient Planning Process: The soil exhibited distinct attributes that deviated from the initial expectations, and the inclusion of labor and materials was not accounted for in the bill of quantities resulting from inadequate attention given to soil analysis during the design stage.	Poor Planning and Estimation: Insufficient project planning and inaccurate early cost estimates have resulted in under-budgeting, which has caused cost overruns during the execution stage.
Cost	A model for luxurious residential projects in terms of value exceedingly exceptionally	The project cost increased tremendously due to poor planning and estimation at the primary stage.
Contracting Company	Sai Consultants	Atelier Consultants

H-House, Surat, Gujarat:

The project faced cost overrun issues primarily due to a deficient planning process. The soil characteristics deviated from initial expectations, and the failure to account for labor and materials in the bill of quantities stemmed from inadequate attention to soil analysis during the design stage. Additionally, poor planning and estimation contributed to under-budgeting, resulting in cost overruns during the execution stage. The cost of the project increased significantly, mainly attributed to these planning and estimation shortcomings.

RP Residence, Greater Noida:

Similar challenges were encountered in the RP Residence project in Greater Noida. The factors contributing to cost overruns included a deficient planning process. The failure to account for labor and materials in the bill of quantities was a consequence of inadequate soil analysis during the design stage. Furthermore, insufficient project planning and inaccurate early cost estimates led to under-budgeting, causing cost overruns during the execution stage. This

project, like H-House, experienced a substantial increase in costs due to poor planning and estimation.

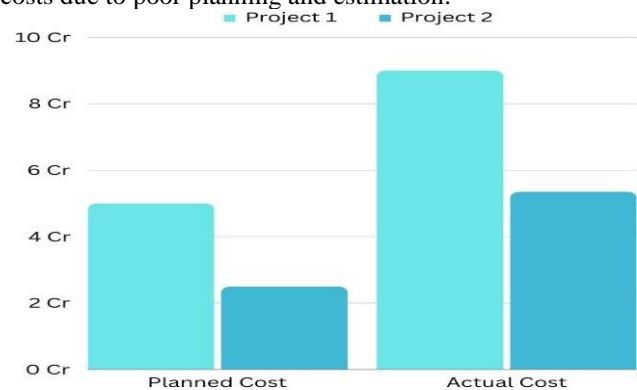


Figure 1: Difference Between Planned and Actual Cost in Examples



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The above two projects are examples where we can observe the cost overrun occurring due to poor planning or design changes during the initial phase of the project. Project 1 (H-House) initial cost which was estimated before the execution of the project was 5.0 Cr and it increased and went up to 9.0 Cr when the project was completed. The reason for such a huge increase in the cost was the poor soil analysis done before the execution of the project which led to inaccurate structural design and wastage of material, later it was corrected.

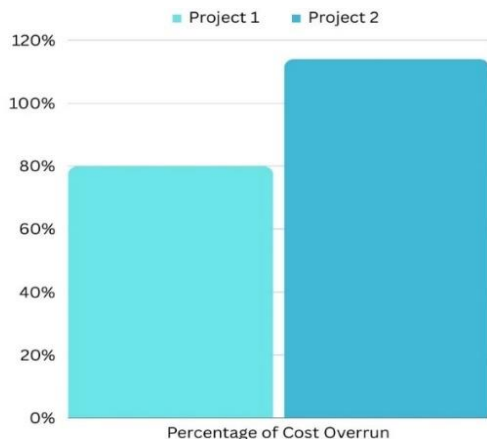


Figure 2: Percentage of Cost Overrun in two Examples

Similarly, for Project 2 (RP residence) the initial cost estimated was 2.5 Cr before execution of the project which increased and went up to 5.35 Cr when the project was completed. The reason for this project was the poor calculation of materials and labor charges in the BOQ at the initial stage of the design.

Residential Projects in India: The Indian construction industry is bustling with activity, primarily driven by the swift construction of residential buildings to cater to the nation's growing population. Demographics significantly influence this construction boom. Projects are intricate and unpredictable, often undergoing changes in various procedural aspects, impacting quality, causing delays, and resulting in cost overruns.

Significance of Residential Projects in India

The significance of housing projects in India is underscored by the escalating demand for private housing initiatives. As a result, construction firms are compelled to initiate projects that align with the diverse standards and preferences of the population. Meeting the high demand density necessitates extensive research studies to ensure optimal efficiency within the currently available options and in the shortest possible time. India faces a significant housing challenge, necessitating government intervention to meet market demand, especially for the youth and low-income citizens. Adequate housing is a widespread and far-reaching issue, requiring joint efforts from the public and private sectors. In the 21st century, citizens' fundamental needs include food, clothing, and proper housing [7]. Projections suggest the residential construction market will expand due to population growth and urbanization trends, making it a key driver for growth in the housing sector.

Value Management Methodology: Value Management Methodology (VM) is a systematic approach aimed at enhancing project outcomes, particularly in construction and design projects. It focuses on balancing essential tasks, expenses, and resources to ensure successful project completion. VM serves as the foundation for Value Analysis,

Value Management, and Value Engineering [1][2][10][11][12][13][14]. Value Engineering is a strategic management technique within the VM methodology, aimed at optimizing the balance between cost, reliability, and product performance. Its goal is to strengthen managerial capacities by identifying and eliminating unnecessary expenses while maintaining or improving product performance [6]. Practitioners of Value Engineering prioritize cost reduction and may assume associated risks, often impacting other functions. Success in Value Engineering relies on coordinated team compositions and the exploration of innovative alternatives. Value Management (VM) is a structured, multidisciplinary effort focused on analyzing project functions to achieve optimal cost reduction. It emphasizes team-based decision-making to deliver the best value. VM is particularly beneficial in the early stages of project development, enabling proactive optimization of project outcomes.

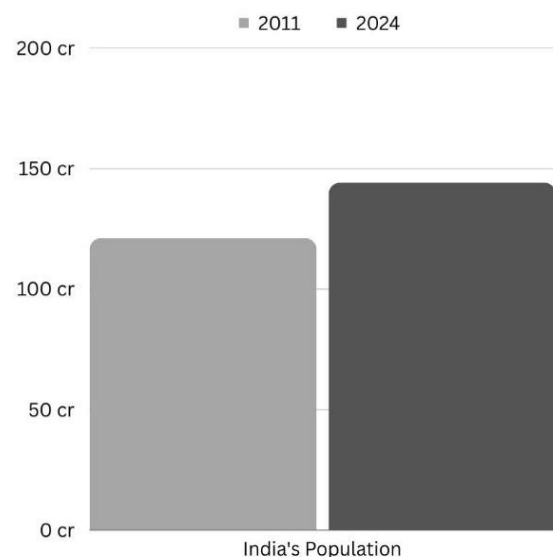


Figure 3: India's Population (in Crores)

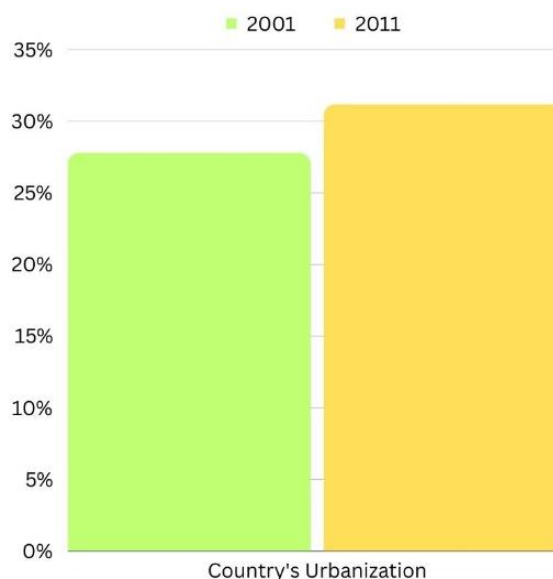


Figure 4: India's Urbanization Rate



IV. ROLE OF VALUE MANAGEMENT

Value Management (VM), also known as Value Engineering (VE) or Value Analysis, is essential for optimizing resources, enhancing efficiency, and maximizing value throughout a project. Its primary focus is on achieving project objectives at the lowest possible cost while maintaining high-quality standards. VM emphasizes functionality and quality by identifying cost-effective alternatives, eliminating unnecessary expenses, and introducing innovative solutions. VM plays a crucial role in efficiently allocating materials, labor, and time for project success, reducing delays, disputes, and cost overruns. It prioritizes stakeholder satisfaction by aligning project outcomes with their needs and provides a systematic decision-making framework that encourages innovation and streamlines processes. Throughout the project lifecycle, VM ensures lasting benefits in design, construction, operation, and maintenance, promoting sustainability by identifying eco-friendly alternatives and minimizing waste [4]. The user's value measure is provided by three basic elements: function, quality, and cost as shown in Fig.5.

Overall, VM systematically enhances project value by optimizing costs, resources, and functionality while achieving crucial objectives such as time and cost optimization, quality enhancement, accurate decision-making, and promotion of teamwork.

The assessment of the worth of a user is determined by three fundamental components: functionality, quality, and cost. The elaboration of these elements is presented by the following equation [5].

$$\text{Value} = (\text{Function} + \text{Quality}) / \text{Cost}$$

$$\text{Value} = (\text{Performance}) / \text{Cost}$$

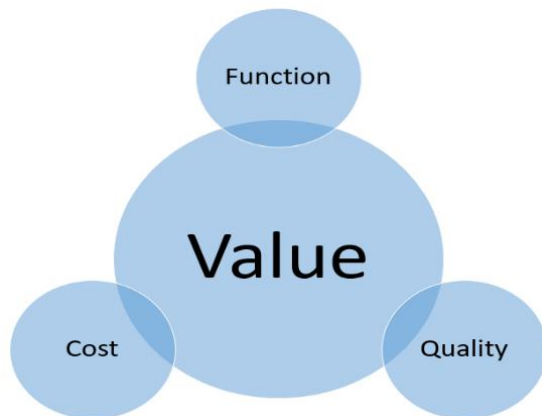


Figure 5: Relation Between the Value Engineering Factors

Phases of Value Management Process

Information Phase: This phase focuses on understanding the project's context, identifying stakeholders, defining objectives, and establishing constraints and requirements to lay a comprehensive foundation. **Function Analysis:** This phase involves breaking down the project into fundamental functions or components, and gaining a clear understanding of essential requirements and objectives.

Creative Phase: Participants brainstorm and generate innovative ideas and solutions to enhance project functions and achieve objectives more efficiently, exploring various possibilities.

Evaluation Phase: This phase assesses and analyzes generated solutions based on criteria such as cost, functionality, and feasibility to identify the most viable alternatives. **Development Phase:** The most promising alternatives are refined and developed further through detailed planning, prototyping, or modeling to ensure practical implementation.

Presentation Phase: The final phase involves presenting recommended solutions to stakeholders, detailing benefits, impact on objectives, and alignment with project goals to obtain buy-in and support.

Overall, the Value Management process systematically progresses through these phases, fostering collaboration, creativity, and informed decision-making to optimize costs, resources, and functionality, enhancing the project's overall value [3].

Application of Questionnaire Survey

A survey was conducted to evaluate the impact of Value Management (VM) integration on residential projects in India. Targeting architecture designers, site engineers, and structural engineers, the study aimed to assess respondents' familiarity with VM and its frequency of use. Additionally, it sought to determine VM's effectiveness in controlling cost overruns using a common cost model. The survey was distributed to 80 professionals, achieving a response rate of 28%, highlighting challenges in gathering responses within this industry context. The impact of applying VM on controlling cost overrun was evaluated. Fig.7 summarizes the specifications on the 2 selected projects.

Point of Comparison					
Project 1			Project 2		
Flooring	Flooring before VM	Flooring after VM	Flooring	Flooring before VM	Flooring after VM
Floor material	20mm thick base of cement mortar (1:4)	20mm thick base of cement mortar (1:4)	Floor material	20mm thick base of cement mortar (1:4)	20mm thick base of cement mortar (1:4)
	18mm Thk Italian Marble	Vitrified tiles (600mm x 600mm)		18mm Thk Italian Marble	Vitrified tiles (600mm x 600mm)
	White cement slurry @ 4.4 kg/sqm	Grey cement slurry @3.3 kg/sqm		White cement slurry @ 4.4 kg/sqm	Grey cement slurry @3.3 kg/sqm

Figure 7: Comparison Between Analysis of 2 Examples Before and After Applying VM

The survey mainly received responses from Architecture designers, highlighting their important role in the residential building process, particularly junior architects with less or around 5 years of experience who possess significant knowledge and actively apply Value Management (VM),

emphasizing their significance in the application and understanding of VM in residential construction.



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Questionnaire Survey

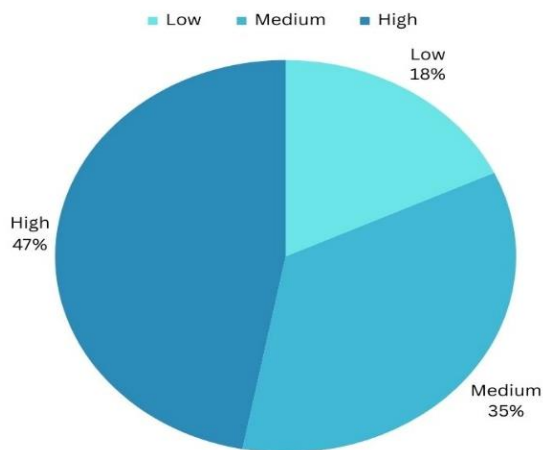


Figure 8: Percentage of using Value Management

V. VALUE MANAGEMENT

Fig. 8 depicts the degree to which Value Management is employed within the construction industry. It showcases that a significant number of participants have expressed their inclination to utilize VM for residential projects to a moderate extent. This serves to highlight the essentiality of VM in the realm of construction. Conversely, Fig. 9 demonstrates the level of respondents' comprehension of VM, with approximately 49% of participants affirming that stakeholders possess an adequate level of understanding.

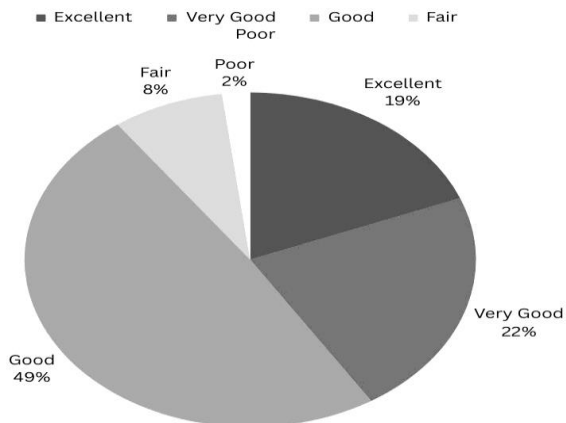


Figure 9: Level of Awareness of Value Management

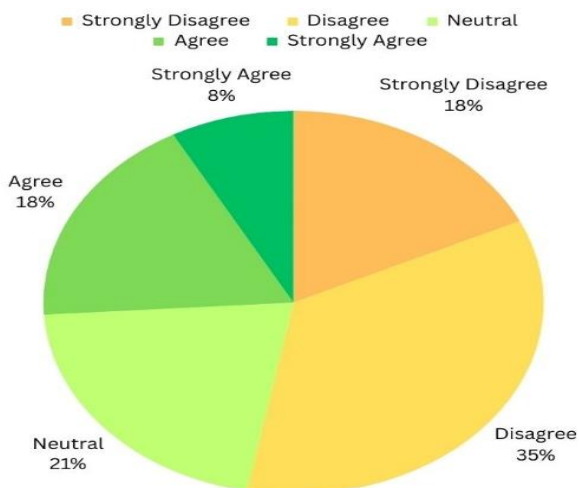


Figure 10: The Percentage of VM Application in Residential Projects

Fig.10 depicts the degree of concurrence of the utilization of value management in residential construction endeavors, wherein a substantial portion of the respondents evince concurrence or resolute concurrence with said notion. Fig. 11 showcases the level of unanimity regarding the prompt implementation of Value Management. Concerning the importance of incorporating VM from the initial stages of conceptualizing residential projects, more than half of the participants concurred.

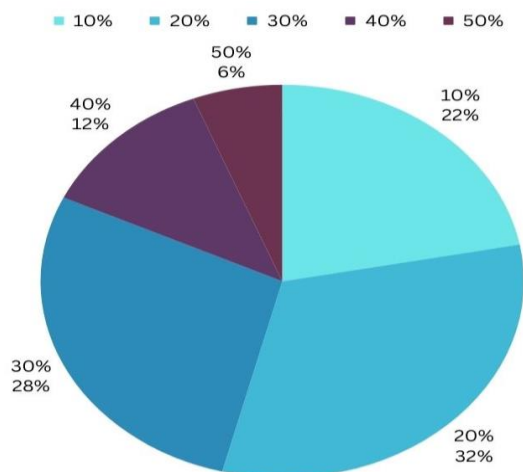


Figure 11: Agreement on the Application of VM in the Early Stage of the Project

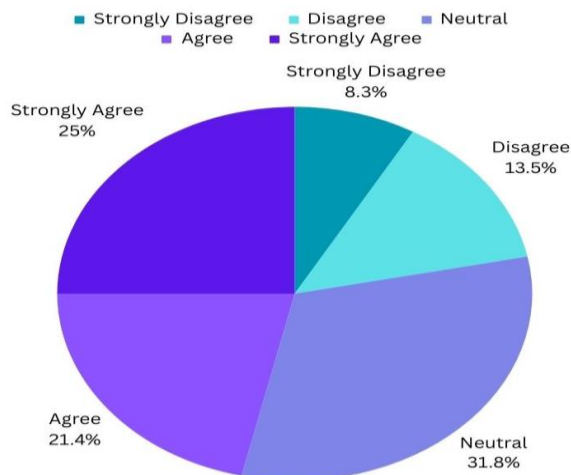


Figure 12: The percentage of Cost Saving by VM

Fig. 12 exhibits the proportion of financial savings achieved by implementing value management. Many participants expressed that value management would be associated with either exceeding project budget, product excellence, or fostering team cohesion.

Data Analysis:

Based on the analysis of the findings derived from the questionnaire survey, thorough review of relevant literature, and meticulous analysis of illustrative instances, the authors have observed the mutually agreed upon significance of value management in residential construction projects. This is visually presented in Fig. 13. It is worth noting that there are potential benefits that can be obtained through the implementation of VM, which may pertain to either cost overruns, product quality, or the construction team.



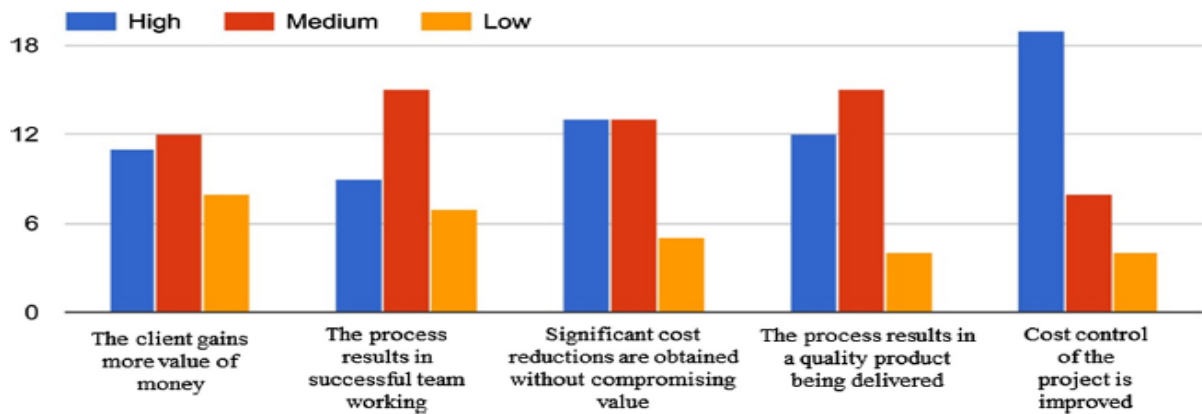


Figure 13: The Advantages of using VM in Residential Building Projects



Figure 14: Result of Cost Saved by VM Methodology in the two Example Projects

VI. CONCLUSIONS

The findings of the study indicated that the analysis of residential project cases in India provided evidence that the percentage of cost overrun in construction projects ranged from 25% to 40%, which highlights the need for the implementation of a value management process to effectively achieve cost control. For instance, in Project 1 we can observe a remarkable 40% reduction in the cost of flooring selection. On the other hand, Project 2 focused on flooring selection based on the design code requirements, resulting in cost savings not only in the material but also in labor installation charges. This particular example managed to achieve a noteworthy 25% reduction in cost from the original cost of all architectural works in the projects. Drawing from the conclusions of this study, it is evident that value management plays a significant role in the realm of residential construction, as highlighted by the various potentials identified through the study's findings. These potentials include an improved ability to control project costs, the ability to achieve cost reductions without compromising on value, the enhancement of value for the client in terms of monetary value, and the delivery of a high-quality end product. Moreover, the implementation of the value management process fosters successful team collaboration, thereby contributing to the overall success of the project. In summary, it can be asserted that the application of the value management methodology and its different phases result in a noticeable improvement in value. The research

considerations of value management have proposed several alternative approaches that have proven to yield cost savings ranging from 25% to 40%, by effectively reducing costs associated with specific items. This conclusion is further supported by the results obtained from the survey questionnaire, which demonstrated the high impact of applying value management in residential construction projects, particularly in cost reduction.

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Authors Contributions	All authors have equal participation in this article.

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