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A RESEARCH ON CRITICAL SUCCESS FACTORS FOR HIGH-RISE BUILDING PROJECTS: A COMPREHENSIVE ANALYSIS

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ABSTRACT
Construction of high-rise buildings is a complex and multifaceted process that requires intensive planning, resource management, and stakeholder coordination. This research examines the critical success factors (CSFs) that influence the successful delivery of such projects, with specific focus on their development in line with shifting technological, environmental, and social trends. Classic CSFs such as cost containment, on-time delivery, and quality control have come to incorporate sustainability, computerization, and customer-driven processes as essential pillars of success. A systematic review of the literature, qualitative surveys, quantitative statistical analysis, and the implementation of project management technology such as Work Breakdown Structure (WBS) and Building Information Modelling (BIM) are applied in the mixed-methods process of this research. The "Stargaze" project, located in Bavdhan, Pune, serves as a case study for illustrating real-world applications of these factors. Important findings reveal cost control, schedule compliance, optimization of resources, and stakeholder satisfaction to be essential for the success of a project. Moreover, sustainability-oriented approaches, including the use of energy-efficient materials and waste management practices, are viewed as essential within today's construction projects. This research stresses the need for technology innovation like BIM to maximize project processes, reduce errors, and enhance collaboration across diverse project teams. This research gives pragmatic insight into maximizing high-rise development projects by performing rigorous analysis and milestone mapping. It strives to enable developers, politicians, and stakeholders to attain sustainable and effective urban development.

Keywords:
Critical success factors, high-rise buildings, Building Information Modelling (BIM), sustainability, project management, stakeholder satisfaction, resource allocation, etc.

1. INTRODUCTION

General

The progression of critical success factors (CSFs) in residential initiatives is indicative of a dynamic environment influenced by shifting consumer expectations, technological innovations, and market demands. Comprehending these elements is critical for stakeholders, investors, and developers to successfully navigate and prosper in the fiercely competitive real estate industry [1]. The notion of what qualifies as a critical success factor in residential initiatives has undergone substantial development over time. In the past, considerations such as cost control, punctual completion, and high-quality building were considered critical [2]. Although these factors continue to be crucial, the contemporary viewpoint incorporates a more extensive range of considerations.
Sustainability is an important facet of evolution [3]. As a result of increased environmental consciousness and stricter regulations, residential construction projects must now incorporate energy-efficient designs and environmentally favorable practices [4]. Key determinants of project success now

include LEED certification, carbon footprint reduction, and the utilization of renewable materials; these factors significantly impact market perception and long-term sustainability [5].

Additionally, customer-centricity has become a defining CSF. Modern purchasers are more discerning; they pursue holistic lifestyles in addition to residences [6]. Key determinants of project success include location convenience, amenities, and smart home technologies. By utilizing market intelligence and data to align offerings with demographic preferences, developers have the ability to augment customer satisfaction [7]. Likewise, the digital revolution has transformed CSFs. At present, the achievement of project objectives is heavily reliant on technological advancements, such as virtual reality (VR) for immersive pre-sales experiences, project management software to optimize workflows, and Building Information Modelling (BIM) to enhance design efficiency [8]. Compliance with these technological advancements is now crucial for achieving operational excellence and competitiveness [9]. In addition, the significance of regulatory compliance and risk management has increased as pivotal determinants of success [10]. Proactive adaptation strategies are imperative due to evolving geopolitical factors, zoning regulations, and permit procedures. Projects that effectively manage legal complexities generally attain more favorable results [11].

Fundamentally, the transformation of critical success factors in residential construction projects signifies an adoption of a more comprehensive and fluid methodology. In the contemporary real estate industry, it is imperative to incorporate sustainability, customer-centricity [12], technology, and risk management into project strategies in order to attain exceptional results; this is no longer a discretionary element. This article examines the implications of these evolving CSFs and proposes strategies for effectively utilizing them to propel residential development success [13].

Define critical success factors (CSFs)

Constituents which establish success for the completion and construction of residential development. Project objectives find their realization through CSFs that lead to overall project success. Residential building projects normally rely on essential elements combined to reach desired performance targets which include [14].

Fig. 1. Critical Success Factors (CSFs)

Market Demand and Feasibility

Significant changes have occurred in residential development critical success factors because of renewed interest in matching market demand and feasibility. The pivotal success assets during the initial stages consisted of architectural design and construction quality. Market demand together with project feasibility analysis becomes crucial due to shifting customer tastes and economic market dynamics. Real estate developers have made this strategic move to bring residential projects into alignment with market needs for long-term operational viability from their initial planning stages [15].

Financial Viability

The evolution of financial viability into the 21st century as a critical success factor for residential projects has focused increasingly on more advanced financial modelling and risk assessment instead of traditional cost management techniques. Contemporary residential projects have moved from stress on purely profit-making ventures to encompassing holistic financial viability **[16]**. Such financial viability involves combining life cycle costing, sustainable developments, and long-term return on investments. This development underscores the strategic transition towards overall financial management, which ensures that the projects remain viable and strong in an ever-changing market scenario **[17]**.

Quality of Construction

Because of Critical success criteria' progression in residential project management, the emphasis on construction quality has shifted considerably. Initially, cost management and timely completion constituted success indicators. On the contrary, contemporary endeavours place significant emphasis on the quality of construction—encompassing materials, craftsmanship, and compliance with regulations and standards. Presently, quality assurance processes and technologies such as Building Information Modelling (BIM) are of the utmost importance in guaranteeing customer fulfilment and elevated standards [18].

Effective Project Management

From the very start of the woodlands of these four distinct Kenyan regions, this trend has been observed and noted as shaping residential building construction with a considerable impact. Not very long ago, characteristics like cost control were among the most appreciable while most attention was paid, at present, to establishing consumer satisfaction, effectively integrating technological processes in the sector on the basis of sustainability concepts. Today, agile mechanisms, collaboration among stakeholders, and advanced project management tools used for communication during decision-making are the crucial methodologies employed, and these are what finally guarantee the success of contemporary residential development projects [19].

Importance of understanding CSFs for project success

To secure the success of a housing project, it is paramount to identify the Critical Success Factors (CSFs). CSFs are crucial to assure project objectives are attained and stakeholders satisfied. Identifying and understanding these factors early within the project framework allows stakeholders to deploy their time and resources more efficiently **[20]**, enhancing decision-making quality and ensuring the project is successful. Having this understanding enables proactive risk management and mitigation, ensuring that the project continues to progress according to plan and yields the awaited results in the most efficient manner **[21]**.

Project Focus and Alignment

The definition of factors for critical success currently comes with a switch in orientation toward focus and alignment of housing and other projects. This necessitates focusing on well-defined project aims, establishing coordination among stakeholders, and efficient distribution of resources. Nowadays, projects prioritize innovation, sustainability, and customer-centric strategies for long-term success. The success of residential projects is now drastically dependent on the implementation of organizational strategies that enable seamless integration of project objectives [22].

Resource Allocation

With the emergence of critical success factors in residential construction, the allocation of resources has become an important determinant. To optimize project costs and timelines, effective resource utilization requires proper balance of labour, materials, and equipment. Through the advancements of Building Information Modelling (BIM) and project management software, resource planning has seen a significant change as it is now auguring well for better co-ordination and outturn at residential construction sites [23].

Performance Measurement

In recent times, massive changes have taken place in the evolution of critical success factors for housing projects due to a stronger emphasis on performance measurement [24]. This includes assessing into account in a quantifiable manner all project objectives, timings, quality standards, and stakeholder satisfaction. Performance assessment is widely used to ensure congruency with strategic objectives, provide for continuous improvement, and further develop the quality of the decision-making procedure. It helps maximize adequate strengths and highlights areas that require improvement, hence promoting project success and sustainability [25].

Continuous Improvement

The introduction of the process of continuous improvement became a pivotal aspect in strengthening residential project success factors. Initially, priority was given to meeting the essential quality and cost objectives. Continuous improvement has now become a principal dictate due to changing customer expectations and the dynamic nature of the market. This calls for the application of new thinking, continuous improvement, and flexibility for the project to continue to be successful for many years to come **[26]**.

Types of critical success factor

Fig. 2. Types of CFS's

The figure presents a comprehensive breakdown of Critical Success Factors (CSFs) categorized into two main types: Primary CSFs and Secondary CSFs, each contributing distinctively to the success or failure of a project [27].

The major CSFs anchor one-to-one relationship with project outputs. They are Cost, which covers financial issues that are important for budget cohabitation and resource allocation; Schedule, which contains the timely delivery of project phases and overall duration control over practical realities; Quality, which shows the standards and actions set for outputs and workmanship [28]; Scope, which is what the project is trying to achieve, which is the project objectives, tasks to be completed, and the limit; Resources, which include availability and the employ of human, material, and financial resources vital to implement the project; Work Process within Resources covers processes, techniques, and flow of tasks used to normalize and enhance productivity and effectiveness; and lastly, Stakeholder Satisfaction meets the expectations of stakeholders, meet their various concerns, and maintain good relations during the project lifecycle [29].

Secondly, the Secondary CSFs apply an indirect influence on the success or failure of a project. They include Communication Effectiveness-which is about the degree to which communication channels and strategies between team members, project team leaders, and stakeholders have been established and implemented; Risk Management-discussion about specific procedures for identifying possible risks that might affect project objectives and outcomes, assessing those risks, and then taking certain mitigating actions [30]; Leadership-how effective leadership leads, motivates, and guides teams in

decision-making during challenges so that all effort is aimed at achieving project objectives; Organizational Culture-the values, norms, and beliefs in a particular organization exhibited by behavior, collaboration, and performance; and finally, Technological Capabilities-how technology and digital tools can facilitate project improvement and enhancement with respect to its efficiency engagement, innovation, and competitiveness [31].

It is very important to manage these Primary and Secondary CSFs for the success of any project. It requires an integrated holistic approach to financial control, scheduling, quality management, clear definition of scope, resource optimization, smooth workflow processes, stakeholder management, good communication, proactive risk management, leadership, an organizational climate that is supportive of personal initiative, and advancing technology. By acting sincerely and genuinely on all these CSFs, project managers can develop an all-around improvement in project performance, lead answering the risks, and aspire to achieve their specified outcomes in a dynamic yet competitive environment [32].

Evolution of residential projects

A driving force behind the emergence of critical success factors in residential construction would have evolved from technological advancements and constantly changing demands in society. Early performance in the instance of projects was given pro-forma judgment on the same ground as adherence to schedules and cost management. In contrast, modern residential developments demand a broader approach, emphasizing sustainability, integration into the community, and innovative design. The world of commercial construction has grown ever more complex-they call it the new normal-because of the rise of smart technology, green building practices, and user experience-oriented standards [33].

Basic Amenities and Construction Quality

An early stage-means the mark of success lay in the development of some basic amenities and the assurance of quality construction. These ensure the project is viable and meets the customer's demands. However, as the sector matured, other factors came into play, including community contributions, energy efficiency, sustainability, and smart home features. In fact, wholesome residential projects in today's world must now balance conventional and modern values to meet the demands and wishes of the newly considered modernized homebuyers **[34]**.

Technological Advancements

Technological improvements have made a very remarkable impact on CRFs in the area of residential construction. In modern times, projects have functioned based on such technologies as Building Information Modelling (BIM), advanced building materials, and project management software applications. BIM improves collaboration, reduces errors, and enhances design accuracy **[35]**. Likewise, by the ability to use advanced construction materials, greater durability and sustainability have been introduced. Furthermore, project management software eases task management and communication so that the purpose achieves its scheduled due date without exceeding the stipulated cost or budget limits **[36]**.

Sustainability and Green Building Practices

The development of important success elements for residential buildings has undergone a significant shift, with a greater focus on green building practices and sustainability. Presently, these elements are regarded as critical determinants of project success, an indication of evolving societal values and concern for the environment. Sustainable methodologies, including but not limited to energy efficiency, utilisation of environmentally friendly materials, and incorporation of renewable energy sources, have emerged as critical components in guaranteeing the feasibility of projects and satisfying the demands of stakeholders. Sustainability is currently a critical success factor in the residential development industry [37].

Quality of Life and Community Integration

The evolution of crucial success elements for residential complexes has undergone a significant shift, with a greater focus on quality of life and community integration. A decade ago, cost and time

adherence constituted the primary determinants of success. Nonetheless, in light of shifting societal values, an increasing priority is placed on designing environments that improve the quality of life for inhabitants and promote the integration of communities. At this time, the success and sustainability of residential developments are largely determined by elements such as verdant spaces, amenities, and social infrastructure [38].

Expansion and Urbanization

Critical success elements in residential projects: their progression has been significantly influenced by the expansion and urbanization of cities. As urban areas grow and diversify, factors like location accessibility, sustainability, and community amenities have become paramount for project success. Developers now prioritize eco-friendly designs, integrated infrastructure, and social spaces to cater to changing lifestyles and needs. This shift reflects a broader trend towards creating holistic, connected living environments amidst urban expansion [39].

This research on residential project critical success factors evolution conducts an extensive analysis of time-dependent elements affecting project success outcomes. This research investigation explores residential project management dynamics through analysis of elements which have adapted to changes in socioeconomic conditions and technological development and environment. Together with stakeholder involvement, project planning, risk management, sustainability components, and developing technology implementation make up the complete scope of this study. The study delivers essential knowledge to industry professionals and academic researchers alongside policymakers who work in residential project development through historical success factor investigation [40].

The development of critical success factors in residential projects continues as a complex process which changes because of multiple influencing elements. Residential project success factors acquire rising importance due to economic market shifts as well as societal development and technological transformations in the real estate sector. The goal of this investigation explores changes in residential project critical success factors across historical periods while recognizing market changes and legal requirements together with environmental needs and consumer needs. The investigation analyzes changing CSFs to provide essential insights beneficial for stakeholders who wish to enhance real estate project planning and execution results [41].

2. LITERATURE REVIEW

Mohammed Furkhan et al. (2023) Researchers at the study entitled "A Study on Factors Influencing Cost Overruns in High-rise Building Construction across India" examined the causes behind project schedule and budget revisions in urban development construction. Construction projects throughout India frequently face extreme budget overrun issues which create substantial challenges for project execution and time and budget management for managers architects engineers and contractors. This research examined the primary causes behind cost overruns in order to develop solutions for their correction. Expert evaluations and literature research describe 70 specific elements which trigger cost overruns in construction projects. A total of 101 survey responses came from construction experts across India who answered a Google Form questionnaire among the 150 experts contacted. The analysts used a five-point Likert scale together with the Relative Importance Index (RII) technique for data analysis [42].

Dennis P. Clougherty et al. (2023) provided an overview of the Critical Project Success (CPS) factors for construction projects in India. To complete a project successfully, set goals must be met, and project procedures must be implemented in a performance-friendly atmosphere. Because of their dynamic character, construction projects are especially subject to different uncertainties that might have an influence on their aims. The study aimed to find CPS factors that improve project success by reviewing existing data and project management theories. The authors identified important risk factors in Indian construction projects and related CPS factors to these risks, therefore mapping critical facilitators of success in the Indian construction sector. These enablers were classified based on their scope of project impact [43].

Saket Patni et al. (2023) investigated the causes of cost overruns in Indian high-rise housing projects. The goal of the research was to identify the variables that affect the cost of high-rise housing projects, particularly those under the authority of head contractors. Experts from the public and private sectors who have experience working on high-rise housing developments were surveyed using a questionnaire. The elements were ranked according to their effect and frequency using the Index of Relative Importance. The study found key factors that may be controlled by head contractors, including labor productivity, supplier and subcontractor performance, equipment productivity, site management, scheduling, procurement planning, and skilled labor shortages [44].

Zhen Li et al. (2022) conducted an analysis of high-rise building construction technology in their study "Analysis of High-rise Construction Technology of High-Rise Building Construction." High-rise buildings are complex systems that need stringent technical standards, many construction linkages, and meticulous attention to construction technologies. The study stressed the significance of matching construction features and needs while using different construction methods. The study sought to provide light on the stability and long-term growth of China's construction sector [45].

Bilal Manzoor et al. (2021) investigated the impact of Building Information Modeling (BIM) installation on high-rise building sustainability in their study "Influence of Building Information Modeling (BIM) Implementation in High-Rise Buildings towards Sustainability." The study stressed the need of incorporating sustainability principles into high-rise building design at all stages of decision-making. The study used exploratory factor analysis (EFA) and structural equation modeling (SEM) to identify key success factors (CSFs) for BIM deployment. BIM improves sustainability, productivity, coordination, safety, and visibility in high-rise buildings, according to the findings, which were based on a questionnaire survey of 205 stakeholders [46].

In their study, Kishen Murali et al. (2021) focused on essential management factors for controlling safety and health in high-rise building construction projects. A questionnaire study was conducted, with respondents drawn from high-rise developments in Johor and Melaka, Malaysia. The study measured respondent demographics using frequency and percentage distributions, while essential managerial factors were assessed using the Relative Importance Index (RII). The study discovered that the occupational safety and health committee had the greatest influence on managing safety and health in high-rise building construction projects [47].

A Study on the Assessment of Risk Management in High-Rise Buildings was conducted by JS Raamkumar et al. (2022). This study emphasized the increased risk factors that come with the complexity and dynamic nature of high-rise construction activities. The study conducted a quantitative survey to examine several risk management factors in high-rise buildings in Chennai, Tamil Nadu. The study discovered that the work environment was the most important element impacting risk management in construction projects, with reliability analysis indicating that all factors had Cronbach's values more than 0.7 [48].

Tran Tuan Kiet et al. (2022) presented methods to decrease factors impacting construction delays in high-rise building projects in their study titled "Proposing solutions to reduce factors affecting the delay of construction phase in high-rise building projects." The study examined nine types of solutions for reducing delays in high-rise construction projects, concentrating on factors such as trained personnel, appropriate construction techniques, material supplies, and contractor capability. The offered solutions are intended to assist stakeholders avoid delays and enhance project timeframes [49].

In their study "An Integrated Sustainable Construction Project's Critical Success Factors," Ahmed S. El Touny et al. (2021) defined integrated sustainable critical success factors (ISCSFs)." The study sought to identify and prioritize the factors that influence the success of Egyptian construction projects, especially in terms of sustainability. The study addressed the dynamic and complex character of construction projects, highlighting the need of overcoming numerous difficulties and limits by identifying crucial success factors that lead to successful and long-lasting projects [50].

The critical success factors (CSFs) affecting high-rise building projects have a research gap that reveals various unexplored areas that demand attention. While the current literature recognizes several CSFs

such as project planning, resource management, cost control, and risk reduction, there is a paucity of comprehensive frameworks that combine these factors into a coherent model geared to high-rise construction projects. Furthermore, many studies concentrate on the factors separately rather than the interdependence and interactions between them, which are critical for understanding their overall impact on project success [51]. Furthermore, while technological tools such as Building Information Modeling (BIM) are recognized for their potential to improve project efficiency and sustainability, there has been little research into the challenges of implementing these tools in high-rise building projects, particularly in developing countries [52]. There is also a lack of investigation into the local regulatory factors, labor dynamics, and project-specific obstacles that influence high-rise projects differently across locations. Furthermore, while safety management and health practices are recognized as important CSFs, there is a lack of research on how these factors affect high-rise projects, particularly in the context of emerging risks such as those associated with construction site conditions and new building technologies. Finally, research on the role of project stakeholders, such as contractors, architects, and clients, in managing CSFs and ensuring successful project outcomes is limited, especially in the context of high-rise building projects that need sophisticated coordination and communication [53].

3. Methodology

Introduction

With a focus on the case study of the Stargaze project in Bavdhan, Pune, the methodology for this research is to thoroughly analyze the crucial elements influencing the successful completion of high-rise building projects. Using a mixed-methods approach, the research gathers data and evaluates how key success factors (CSFs) in high-rise residential developments have changed over time using both qualitative and quantitative methodologies. The first element of the process is doing a thorough literature study to identify and categorise the important CSFs defined in prior research and industry practices. These factors are then analysed in the context of the Stargaze project, with a focus on project planning, risk management, stakeholder involvement, quality assurance, time management, cost control, and sustainability issues.

The second step consists of gathering primary data via interviews, questionnaires, and site inspections. Interviews will be performed with stakeholders engaged in the Stargaze project, including project managers, architects, structural engineers, contractors, and developers, to learn about the actual issues they confront and the techniques they use to solve them. A survey will also be circulated to relevant people to assess their perspectives on the changing nature of CSFs and their impact on project results. Site observations will be utilised to collect real-time data on construction processes, resource allocation, and quality management techniques.

The third phase includes the application of project management tools and techniques, such as Work Breakdown Structure (WBS) and Microsoft Project (MSP) software, to analyse the project's schedule, cost, and resource distribution. The data generated by these tools will be utilised to measure the influence of detected CSFs on overall project performance, notably in terms of cost and time optimisation. The data analysis will also involve an assessment of project milestones to see how well they fit with the CSFs and if they help to achieve the targeted project results. Finally, the study will conduct a comparative analysis of comparable high-rise projects to corroborate the results and discover trends or patterns in CSF application. The methodology's goal is to give practical suggestions for enhancing project management tactics in high-rise building, resulting in sustainable and successful project completion.

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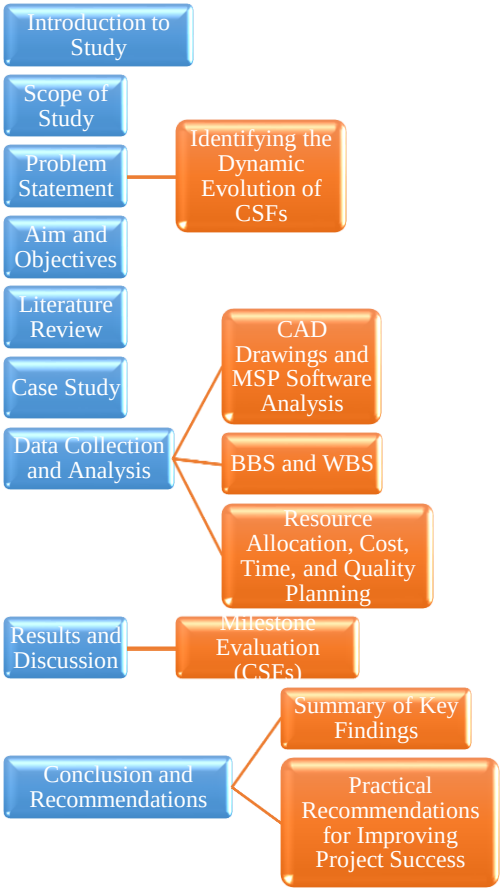

Fig 3. Methodology Plan

4. Case Study

Details: -

The research focused on gathering case study information which appears next. STARGAZE serves as the study site because it exists in Bavdhan at west Pune zone, Maharashtra 411021. JW consultancy operates as the designs and structural engineering team responsible for this project. The project belongs to koltepatil who occupies the ownership role. Manoj tatuskar together with Vikasacharkar serve as the architects who designed this development.

Fig. 4. case study image

Site Details

The place is called Stargaze and is situated in Bavdhan, West Pune Zone, Pune, Maharashtra 411021. The design team is directed by JW Consultancy, while Kolte Patil is the owner and developer. Manoj Tatuskar and Vikas Acharikar are the project's architects, while JW Consultancy serves as the structural engineer. The cost of units in the project begins at 64.4 lakhs. The project covers 1.91 acres and has six residential buildings, each with 14 stories, for a total of 462 apartments. The project focusses on sustainable constructions and is presently under construction. Kolte Patil are the developers in charge of the project.

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5. RESULTS AND DISCUSSION

This research examines the use of quality planning for a high-rise and the variables that affect it, including time, machine, and material construction. To achieve quality, the Stargaze project employed efficient replacement materials such as SA CLC bricks and Gypsum plasters. Machines such as lift machines, compactors, RMC mixers, and cranes are utilised to save time in the WBS (work breakdown structure), resulting in the optimisation of project time and resources. To achieve optimum efficiency, time and resources were optimised, and material was optimised using resource optimisation.

Data Analysis

The project team evaluates CAD designs after data collection while creating new activities that lead to the MSP program insertion of sequences. The BBS (bar bending schedule) preparation from working drawings triggers the description of activities and prepares a work breakdown structure. Project quality depends mainly on time and machine resources and materials as per guidelines in the PMBOK.

After the formation of the work breakdown structure the team assigns time duration to each activity based on original data and adds optional delays or advancements which are referred to as lag or lead. The Quality planning checklist reveals that the MSP scheduling contains 952 days to complete the project along with Rs. 99,602,390.12 in total expenses.

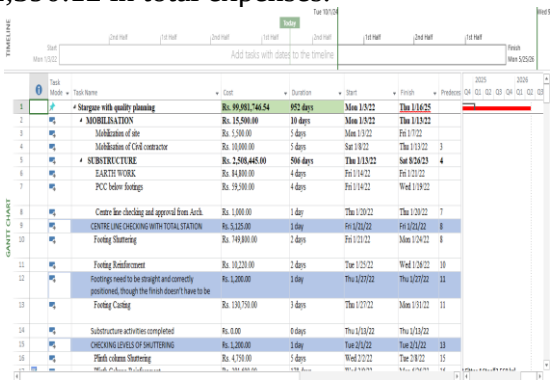


Fig.5. Scheduling of the activities creating WBS

Implementation of WBS for satisfying the quality of project.

The Stargaze website will display our developed work breakdown structure. The work breakdown structure (WBS) operates to transform complex operations into task collections. The project manager uses this planning method to achieve better control over basic assignments. To be effective tasks must contain three main elements: measurable aspects together with independent tasks that have defined performance boundaries. The project scope requires that all work activities have one assigned task while there must not be any non-project work within these tasks. Project management provides exact budget figures for WBS activities because these activities become visible to project managers. Project managers utilize the work breakdown structure (WBS) to divide project funds into established cost packages that link to project tasks though task expenses must remain at or below the project budget. Quality check additions to the work breakdown structure will result in elevated checking process requirements for both costs and materials.

The linking section concludes by preparing an excel file which defines the labour costs related to various materials including CP fittings, course and fine aggregate, cement, bricks, tiles, mobilization supplies, and materials for watchman cabins, among other things. These resource sheets present information about both contemporary market rates and work labor expenses. Under the guidelines of BBS (bar bending schedule) the prepared resource sheet uses material specifications along with human resource distributions. Each activity on the MSP programmer receives assigned resources after importing the resource sheet from the system.

Critical success factor achievement

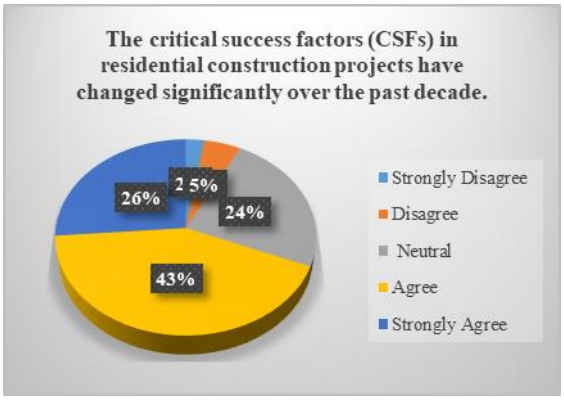
Main performance markers from the case study serve as important milestones for tracking essential success factors (CSFs). Fundamental CSFs like cost management and schedule adherence together with quality assurance and scope definition as well as resource allocation and efficient work

procedures and stakeholder satisfaction exist as specific target achievements in the project timeline. Project success becomes obtainable when we link milestones to CSFs since this method enables us to detect problems early and use strategic planning for proactive challenge management. Through periodic checkpoints we have opportunities to evaluate performance toward data-driven decision making in order to optimize resources and reduce risks for achieving project goals within stakeholder expectations from project start to completion.

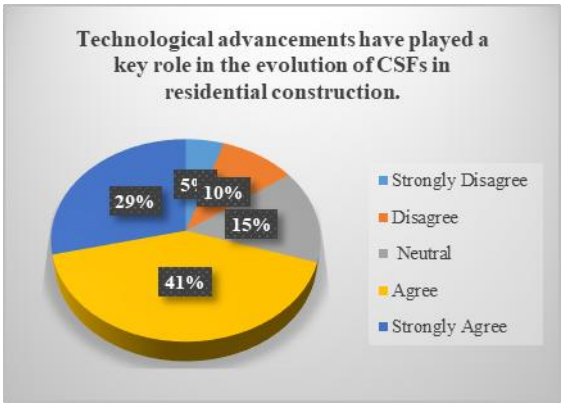
Milestone 1 – Substructure activities completed	The entire cost structure for the project "Stargaze with quality planning" reaches Rs. 99,602,390.12. The project includes several elements that make up its total cost including mobilization and substructure and additional activities. The project budget depends directly on cost because this factor determines financial success.
Milestone 2- Shuttering levels checked	Details regarding cost expenses can be found in the provided data collection. The price for "Plinth column Shuttering" amounts to Rs. 4,750.00 with 5 days duration. Accurate cost estimation combined with expense tracking along with maintaining budget compliance achieves the cost-saving goal of the project.
Milestone 3- Slab work done	Budgets serve as the primary indicator of task costs in the project. Each task includes budgeted costs which add up to Rs. 97.459.045.12 for the whole superstructure project.
Milestone 4- Brickwork done	The overall expense dedicated to brickwork amounts to Rs. 6,878,400.00. The project budget seems to have been effectively managed since cost management proved essential throughout.
Milestone 5- Plastering work done	The entire plastering expenditure amounts to Rs. 1,892,829.44 for both internal and external application. The success criterion for cost lies in staying below its budgeted amount. This information indicates budget compatibility but a cost variance assessment between budget and actual values will help determine the success of cost management strategies.
milestone 6- External plumbing completed	The external plumbing expenses totaled Rs. 1,246,000.00 without exceeding the budget as project reports make no indication of going over financial constraints. The cost data points to proper management of the allocated budget.
milestone 7- Electrical work completed	The electrical work expenses amounted to Rs. 5,162,550.00 and the budgetary constraints were not exceeded during the project. Achievement of cost management goals signals its operational success.
milestone 8- Water proofing	Contractors implemented waterproofing costs at Rs. 2,314,900.00 that fell within the allocated budget for this project.
\milestone 9- External and internal paint work done	Budget management proved effective since the combined expenses for flooring together with internal painting and external painting remained within the set parameters. No cost overruns were reported.
milestone 10- Railing fixed	A cost of Rs. 174,500.00 was paid for the MS Railing for Staircase installation but no details were provided regarding extra costs needed for fixing the railing. Cost performance reached the specified budget level.
milestone 11- Lift work done with all remaining part	The lift work implementation cost Rs. 3,051,200.00 and finished under the established budget constraints. The management of costs reached the predicted total.

Within the scope of this particular case study, a sample size of eighty individuals was chosen from a total population of one hundred people who were connected with the Stargaze project. In order to

estimate the sample size, a conventional approach for calculating sample size was used. This method took into account a confidence level of 95%, a margin of error of 5%, and a population proportion of 50%. This method is traditionally utilised in situations when the precise proportion is uncertain. Considering these criteria, it was determined that a sample size of eighty would be enough to yield statistically valid findings. The population size was one hundred, and the sample size was estimated to be eighty. This sample size is equivalent to eighty percent of the total population, which guarantees that the data obtained will accurately reflect the larger group that is participating in the project and that the conclusions will be statistically valid with the confidence level and margin of error that have been determined.



The data show a considerable distribution of responses to the perception of changes in critical success factors (CSFs) in residential construction projects during the last decade. The majority of respondents agree with this statement, with 34 individuals (43%) agreeing and an additional 21 individuals (27%) strongly agreeing, accounting for 70% of total responses. This indicates a solid agreement that major changes in CSFs have occurred. In contrast, just a tiny minority of respondents disagreed, with two individuals (2.5%) strongly disagreeing and four individuals (5%) disagreeing, indicating limited hostility to the concept of developing CSFs. Notably, a significant proportion of participants, 19 individuals (24%), stayed neutral, showing doubt or ambivalence about the statement. This distribution emphasises the widespread acknowledgement of altering CSFs in residential construction, while also recognising a group of respondents who may want further clarification or information to adopt a firm view.



The responses to the role of technology breakthroughs in the evolution of Critical Success Factors (CSFs) in residential construction are overwhelmingly favourable. A vast majority, with 33 individuals (41%) agreeing and 23 individuals (29%) strongly agreeing, accounting for 70% of total responses, acknowledge the critical role of technology innovations in forming CSFs. A smaller percentage of respondents disagreed, with 4 individuals (5%) strongly disagreeing and 8 individuals (10%) disagreeing, indicating minor dissent to this perspective. Furthermore, 12 individuals (15%) remained neutral, indicating some degree of ambivalence or a lack of firm judgement.

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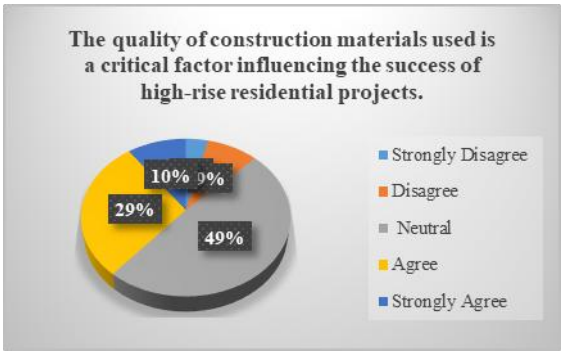
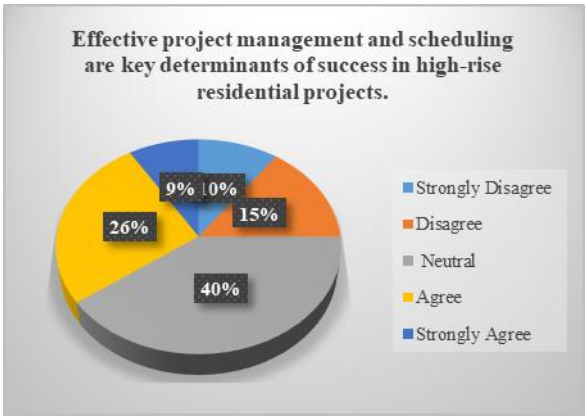
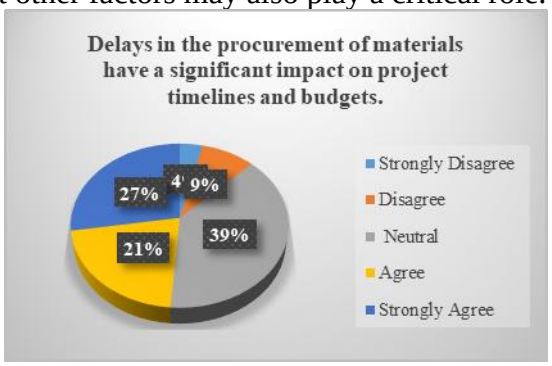


The responses on the impact of construction material quality on the success of high-rise residential projects show a modest degree of agreement, with some opinion difference. The critical relevance of material quality is recognised by a total of 31 individuals (39%), with 23 individuals (29%) agreeing and 8 individuals (10%) strongly agreeing. On the other side, a smaller section disagreed, with three individuals (4%) strongly disagreeing and seven individuals (9%) disagreeing, suggesting minor dissent to the statement. Notably, the biggest group, 39 individuals (49%), remained neutral, indicating that a considerable number of respondents either lack a firm opinion or believe that other factors are as or more critical.



The responses on the importance of competent project management and scheduling in the success of high-rise residential projects show a mixed bag of viewpoints with a modest slant towards agreement. The importance of these factors is affirmed by 28 individuals (36%), with 21 strongly agreeing (27%) and 7 strongly agreeing (9%) individuals. However, 8 individuals (10%) strongly disagreeing and 12 individuals (15%) disagreeing, totalling 25%, reveal a significant section that questions this opinion. 32 individuals (41%), the greatest percentage, stayed indifferent, indicating a high degree of ambivalence or the belief that other factors may also play a critical role.



The responses on the impact of material procurement delays on project deadlines and budgets indicate a clear trend towards agreement. A total of 39 individuals (50%), with 17 (22%) agreeing and 22 (28%) strongly agreeing, emphasise the major impact of procurement delays on project results. In contrast, 3 individuals (4%) strongly disagreeing and 7 individuals (9%) disagreeing, accounting for 13% of the total, show a minority position that reduces the impact. 31 individuals (40%) stayed indifferent,

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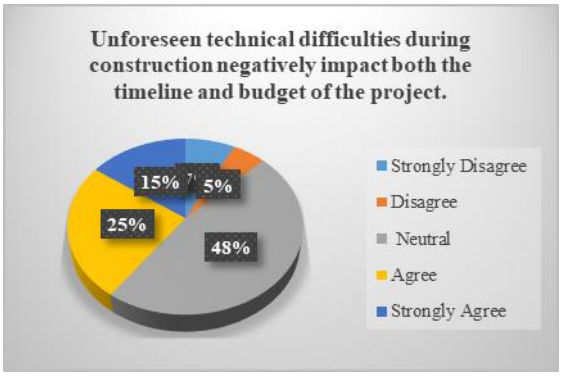
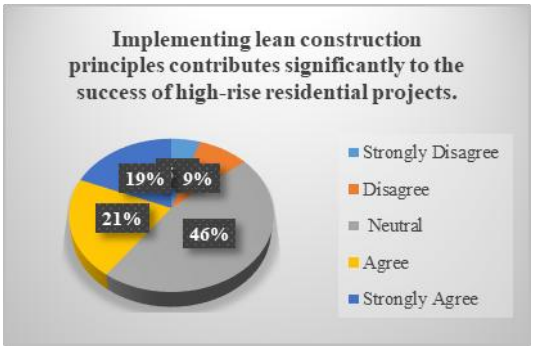
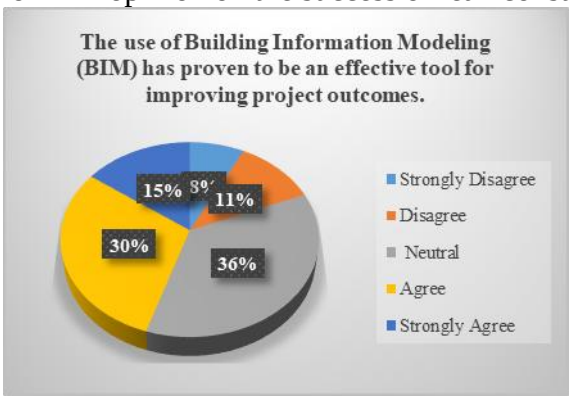
suggesting either doubt or a notion that the magnitude of the impact may depend on project-specific circumstances.



The responses on the impact of unforeseen technical challenges on project deadlines and budgets show a broad consensus, with some diversity in viewpoint. The negative implications of such challenges are recognised by a total of 32 individuals (42%), with 20 individuals (26%) agreeing and 12 individuals (16%) strongly agreeing. In contrast, a tiny number, 6 individuals (8%) strongly disagreeing and 4 individuals (5%) disagreeing, totalling 13%, minimise the importance of these difficulties. The biggest group, 38 individuals (50%), took a neutral approach, indicating that a significant number of respondents may evaluate the impact differently depending on the type and context of the technical difficulties experienced.



The responses addressing the significance of lean construction principles to the success of high-rise residential project show a modest degree of agreement with some difference in perspectives. The substantial role of lean construction principles is supported by a total of 32 individuals (42%), with 17 agreeing (22%) and 15 strongly agreeing (20%). In contrast, a smaller minority, 4 individuals (5%) strongly disagreeing and 7 individuals (9%) disagreeing, combining for 14%, express doubts regarding the impact of these principles. The majority, 37 individuals (49%), remained neutral, showing a high level of uncertainty or a lack of firm opinion on the success of lean construction in this setting.



The responses to the effectiveness of Building Information Modelling (BIM) in enhancing project outcomes are encouraging yet diverse. A total of 36 individuals (46%), with 24 individuals (31%) strongly agreeing and 12 individuals (15%) strongly agreeing, recognise BIM as a useful tool for

improving project outcomes. However, 6 individuals (8%) strongly disagreeing level and 9 individuals (12%) disagreeing level, totalling 20%, suggest considerable scepticism regarding its impact. Furthermore, 29 individuals (37%) took a neutral attitude, indicating that, although many respondents may see BIM's potential, they either lack adequate expertise or are uncertain about its wider application in various project contexts. Overall, these data suggest a widespread acceptance of BIM's effectiveness, balanced by a sizable number of indifferent and disagreeing attitudes.

Conclusion

This study's findings highlight the complex character of critical success factors (CSFs) in high-rise construction projects, demonstrating the dynamic interaction of technological, economic, environmental, and human-centric aspects. The case study of the "Stargaze" project in Pune demonstrates that new construction paradigms demand more than simply adherence to conventional measures such as cost, time, and quality. The study emphasises the critical role of sustainability, modern technological tools, and customer-centric methods in determining project success.

The study found considerable agreement on key factors impacting project outcomes, based on responses from a sample of 80 individuals out of a population of 100 individuals. A significant majority of respondents saw the importance of changes in CSFs, with a big proportion recognising the role of technological advancements in altering these factors. Furthermore, although the impact of construction material quality was universally recognised, many respondents remained neutral, indicating that further research is needed on this issue.

Competent project management and scheduling were also seen as critical, albeit their relative importance was ambiguous. The problem of procurement delays was repeatedly cited as a key concern influencing project time lines and budgets, with many respondents agreeing on its time impact. Similarly, unforeseen technical challenges were recognised, however a large majority of participants remained neutral on their severity, indicating that their impact may vary based on the unique project conditions.

Interestingly, both Building Information Modelling (BIM) and lean construction principles were seen as advantageous, although there was significant neutrality, indicating varying degrees of understanding or expertise among respondents. Overall, the study indicates a broad agreement on the importance of certain factors, but it also emphasises the complexity and variety of perspectives in the construction business. These findings provide valuable insights into the changing character of residential construction projects, emphasising the need of ongoing adaptation and innovation to meet growing challenges and enhance project outcomes.

Key takeaways:

Advanced Technology Integration: According to the study, BIM is a revolutionary tool that increases design accuracy, lowers project risks, and promotes stakeholder cooperation. To face the challenges of today's construction projects, developers must embrace such advances.

Sustainability as a core component: Green construction methods, such as energy-efficient designs and ecologically friendly materials, are in line with society's rising emphasis on sustainability. Projects that include these strategies achieve greater market acceptance and long-term viability.

Stakeholder Satisfaction: Customer-centric tactics, together with good communication and involvement, emerge as critical to project success. Aligning project outcomes with customer expectations greatly increases stakeholder satisfaction and confidence.

Proactive Risk Management: Unexpected challenges such as procurement delays and technical difficulties highlight the importance of proactive risk assessment and contingency planning in ensuring smooth project execution.

Lean Construction Principles: Optimising resource utilisation and minimising waste are critical techniques for increasing operational efficiency and lowering project costs.

This study offers a systematic framework for managing high-rise construction projects in today's quickly changing urban setting, adding to existing information. The findings are especially useful for

industry practitioners, researchers, and regulators, since they provide practical insights into improving project efficiency, sustainability, and stakeholder satisfaction.

Finally, this study emphasises the need of a comprehensive approach to project management that incorporates both classic and current CSFs in order to efficiently negotiate the difficulties of high-rise construction projects. By focussing on sustainability, technology, and stakeholder alignment, the construction sector can handle existing challenges and pave the path for creative and sustainable urban development.

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Competing Interests

"The authors have no relevant financial or non-financial interests to disclose."

Author Contributions

"All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [Guru Joshi] and [R. P . Narwade]. The first draft of the manuscript was written by [Guru Joshi] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript."

Data Availability

The authors are willing to share their study datasets upon request to the corresponding author. These datasets were either generated or analyzed for the current research.

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