An In-Depth Examination of The Critical Factors Affecting the Successful Finalisation of High-Rise Construction Projects

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Abstract. This study delves into the critical success factors influencing the successful completion of high-rise building projects, focusing on factors such as quality management, time optimization, resource utilization, and cost efficiency. The objectives include identifying these critical factors, analyzing their impact on project timelines and budgets, evaluating best practices, and proposing recommendations for enhancing project efficiency and success rates. The methodology involves a comprehensive analysis that encompasses quality planning, data collection, data analysis using MSP software, and a detailed case study of the Stargaze project in Pune, Maharashtra. Results indicate that effective quality planning, including the use of optimized materials and machinery, contributes significantly to project success. Data analysis using CAD drawings and MSP software facilitates project scheduling, cost estimation, and resource allocation. The study concludes that quality planning, along with critical success factors, is essential for mitigating construction defects and improving project outcomes. However, limitations in current project management tools highlight the need for integrated stakeholder management tools and expanded critical success factors to enhance project evaluation and promote sustainability.

Keywords: Critical success factor, high rise building, MSP

1 INTRODUCTION

1.1 General
High-rise building projects stand as remarkable feats of engineering, architecture, and project management, symbolizing human ingenuity and ambition. Yet, their successful completion is a multifaceted endeavor influenced by numerous critical factors. Understanding these factors is paramount to navigating the complexities inherent in high-rise construction and ensuring project success. This comprehensive analysis aims to delve into the myriad aspects that shape the outcome of high-rise building projects. By scrutinizing these factors, ranging from structural considerations to stakeholder dynamics, this study seeks to provide valuable...
insights for stakeholders involved in the planning, execution, and management of such ventures.

In a landscape where high-rise buildings increasingly dominate skylines across the globe, the significance of comprehensively examining the determinants of successful project completion cannot be overstated. By synthesizing existing knowledge and drawing upon empirical evidence, this analysis endeavors to shed light on the intricate interplay of variables that underpin the realization of high-rise architectural marvels. Through an exploration of critical factors such as project planning, risk management, technological innovations, regulatory compliance, and stakeholder collaboration, this study aims to offer a holistic understanding of the challenges and opportunities inherent in high-rise construction. Furthermore, by identifying best practices and lessons learned from past endeavors, this analysis seeks to inform future initiatives and contribute to the advancement of high-rise building practices.

The need for a comprehensive analysis of critical factors affecting high-rise construction projects arises from the inherent risks and uncertainties associated with such endeavors. Factors such as site conditions, structural integrity, project management practices, regulatory compliance, stakeholder collaboration, and market dynamics all play integral roles in shaping the outcome of high-rise developments. Moreover, the interplay between these factors and their potential synergies or conflicts underscore the complexity of ensuring project success. This examination serves as a foundational framework for informed decision-making, strategic planning, and effective implementation throughout the lifecycle of high-rise construction projects.

1.2 Define critical success factors (CSFs)

Crucial success factors (CSFs) pertain to residential projects and encompass the essential components or variables that, when attained or preserved, guarantee the triumphant culmination and transportation of a residential development. These elements are critical in order to accomplish the goals of the project and guarantee its overall triumph. Typically, CSFs for residential initiatives comprise a variety of critical components that are essential for attaining the intended results, including.

1.3 Market Demand and Feasibility

A notable transition has occurred in the evolution of critical success factors for residential initiatives, with a renewed focus on market demand and feasibility. Initially, architectural design and construction quality were critical determinants of project success. Nevertheless, in light of evolving consumer preferences and economic conditions, it has become critical to comprehend market demand and ascertain the viability of projects. This transition signifies a calculated effort to synchronize residential constructions with the demands of the market and guarantee economic sustainability right from the start.

1.4 Importance of understanding CSFs for project success

It is of the utmost importance to comprehend Critical Success Factors (CSFs) in order to guarantee the triumph of residential initiatives. CSFs, which stand for critical success factors or variables, are instrumental in guaranteeing the fulfillment of project goals and the contentment of stakeholders. By recognizing and understanding these elements in the early stages of the project life cycle, stakeholders can allocate their efforts and resources more efficiently, thereby augmenting the quality of decisions and, ultimately, the results of the project. This comprehension promotes the proactive administration and alleviation of hazards, guaranteeing that the undertaking remains progressing as intended and proficiently accomplishes the intended outcomes.
1.5 Scope of the Study
The scope of the study on the evolution of critical success factors in residential projects encompasses a comprehensive examination of key elements influencing the success of such ventures over time. This research will delve into the dynamic landscape of residential project management, analyzing factors that have evolved and adapted to changing socio-economic, technological, and environmental conditions. The scope includes a thorough investigation into project planning, stakeholder engagement, risk management, sustainability considerations, and the integration of emerging technologies. By exploring the historical progression of critical success factors, the study aims to provide valuable insights for industry professionals, policymakers, and academics involved in residential project development and management.

1.6 Problem Statement
The evolution of critical success factors (CSFs) in residential projects is a dynamic phenomenon influenced by multifaceted variables. As the real estate landscape continually adapts to economic, technological, and societal changes, understanding the pivotal factors that ensure the success of residential projects becomes paramount. This study aims to investigate how CSFs in residential projects have evolved over time, considering factors such as market trends, regulatory frameworks, sustainability demands, and customer preferences. By identifying and analyzing these evolving CSFs, this research seeks to provide valuable insights for stakeholders in the real estate sector to enhance project planning, execution, and overall success.

1.7 Aim
The study aims to explore the dynamic evolution of critical success factors in residential projects to enhance understanding and improve project management strategies for sustainable success. It seeks to identify the critical factors influencing the successful completion of high-rise building projects. It aims to analyze the impact of these factors on project timelines and budgets. The study intends to evaluate best practices and strategies for addressing these critical factors effectively. It aims to propose recommendations for improving the overall efficiency and success rate of high-rise building projects. Through these objectives, the research endeavors to contribute valuable insights to the field of construction project management, fostering better outcomes for residential high-rise developments.

2 LITERATURE REVIEW
Mohammed Tayyab et.al (2023) “A Study on Factors Influencing Cost Overrun in High-rise Building Construction across India”
The findings of Spearman's rank correlation test show a highly substantial association between the ranks of criteria reported by the owner, consultant, and contractor. The degree of connection between owners and contractors is the greatest (about 71%). The connection between owners and consultants is the strongest (about 72 percent), while the relationship between contractors and consultants is the weakest (around 63 percent). Cost overruns are a major issue in building projects globally. Most Indian construction projects, especially those involving high-rise structures, have had significant cost overruns. For managers, architects, engineers, and contractors, executing construction projects within the given cost budget has become the most significant and difficult task. Because it is usual for high-rise construction projects to go over budget, the goal of this research is to identify the reasons of cost overruns and provide efficient solutions.
Mark van der Ham et.al (2023) “Overcoming process-related barriers in modular high-rise building projects”

Modular building is about developing building concepts that can be applied multiple times, whereby construction projects must be designed independently. Modules must be interchangeable through equivalent interfaces. This is the opposite of the current construction industry where a one-off project is realized by a unique composition of project partners. It can be said that modular construction is a change from project collaborations to product development. It should be noted that, unlike the manufacturing industry in the construction sector, a unique factor always remains. As the Citizen M Bowery case shows, a ‘hotel-room’ concept has been developed, but due to the constantly changing local circumstances (local regulations, local land, and earthquake zones), the modular concept must be adapted every time. High-rise projects seem to be particularly suitable for modular building methods; however there are still some process-related barriers. Research so far has not focused on collaboration forms for modular high-rise projects.


Public housing projects play a crucial role in providing affordable housing solutions to communities, yet their successful completion within scheduled timelines remains a persistent challenge. This study aims to identify the critical factors that influence schedule performance in public housing projects. Through a comprehensive literature review and empirical analysis, key factors affecting schedule performance are examined, including project planning and management practices, stakeholder collaboration, regulatory compliance, resource allocation, site conditions, and external influences. The findings reveal the intricate interplay of these factors and their impact on project scheduling. This research contributes to the body of knowledge on public housing project management and provides practical insights for improving schedule performance in similar construction endeavors.

Areo Daniel (2023) “Factor Influencing Construction Time And Cost Overrun For High Rise Building Project In Abuja Metropolis”

Based on the findings of the study, the study concludes that among the various factors that causes time overrun, inadequate fund for the project, inadequate planning of project before take-off, inadequate tools and equipment, delay in delivery of materials, subcontractors’ incompetency and design changes during project execution top the list. Adequate funding guarantees reasonable cash flow while good planning ensures uninterrupted progress of work and these are basic ingredients for the realization of key objectives of any project. The project owner and project manager should keep their eyes on these key factors during project execution as these factors could result in reasonable time overrun on projects.

Tran Tuan Kiet et.al (2022) “Proposing solutions to reduce factors affecting the delay of construction phase in high-rise building projects”

Along with the rapid development of the construction industry in recent years, high-rise projects have grown in both quantity and scale. However, delays are common in this type of project in developing countries. It causes significant economic damage and has a very serious impact on investor confidence. Following a previous study on factors affecting the delay of construction phase in high-rise building projects, this study will propose solutions to reduce the factors mentioned in the previous study. Nine groups of solutions corresponding to nine groups of factors will be analyzed in this study. The investor chooses a designer and project management consultant who has expertise, experience and is suitable for the project; the investor clearly determined the scale and purpose of using the project; skilled labor and suitable construction methods; provide adequate and timely materials; the investor has to confirm the contractor’s capacity are suggested as mitigation activities. The results could help stakeholders learn from the mentioned factors and apply solutions so that they can avoid delays.

A construction project is a dynamic and complex process that involves the identification and accurate fulfillment of the predetermined needs and requirements of the clients by the project team. There are many challenges and constraints that prevent the achievement of these predetermined and various requirements effectively and successfully, so the project team must face and overcome these challenges by identifying all the factors that help the project’s success. However, it is still unclear how to measure success for Egyptian construction projects. Despite the fact that several lists of literature-based factors have been compiled, the individual factors appear to be tabulated rather than grouped according to some criteria to aid in the analysis of their interactions and potential consequences. As such, the objective presented in this paper was to identify and prioritize integrated sustainable critical success factors (ISCSFs) that influence the performance of Egyptian construction projects to ensure successful construction projects.

3 METHODOLOGY

3.1 Introduction

The growth of key success factors (CSFs) in residential ventures is influenced by industry best practices, technology breakthroughs, and changing social expectations, resulting in a dynamic character. In order to examine its development, it is important to use a thorough technique that encompasses many pivotal phases. Firstly, doing a comprehensive literature study is the essential element of the process. This involves examining case studies, scholarly papers, and industry reports related to residential project management and critical success factors (CSFs). An analysis will be conducted on the historical views of Critical Success circumstances (CSFs) and how they have evolved over time in response to various circumstances such as economic situations, environmental concerns, and changing consumer preferences. Moreover, it is crucial to use primary research methodologies to get current views and opinions from stakeholders and industry professionals. This may include carrying out focus groups, interviews, or surveys with architects, project managers, and inhabitants. These conversations provide valuable qualitative data on the current perceived importance of certain Critical Success Factors (CSFs) compared to previous years. They reveal emerging trends and areas that need to be addressed.

In addition, the technique is enhanced by using a comparative analysis approach. This approach examines the differences in critical success factors (CSFs) across residential projects in various areas, project sizes, and categories (such as luxurious developments vs inexpensive housing). A comparative investigation reveals how industry-specific dynamics and contextual subtleties affect the development of critical success factors (CSF). Furthermore, engaging in specialist consultations and seminars may provide evidence for outcomes and provide expert perspectives on the ever-changing landscape of residential project management. Experts possess intricate understanding and can shed light on the increasing importance of developing Critical Success Factors (CSFs) such as digitization, sustainability, and stakeholder involvement in modern residential projects.

At the end of the it is essential to compile findings into a comprehensive report or analysis in order to clearly convey the development of critical success factors (CSFs) in residential building. This synthesis should not only describe previous changes, but also predict future trends, anticipating how critical success factors (CSFs) may evolve in response to global megatrends such as urbanisation, climate change, and technological upheaval. Essentially, a thorough technique is used to analyse the advancement of critical success factors in residential constructions. This technique encompasses a range of elements, such as expert consultations, literature review, primary research, empirical analysis, comparative studies,
and a synthesis of results. By using this systematic approach, a comprehensive understanding of the development and adaptation of crucial aspects for success in the field of residential project management is ensured.

Fig. 1. Methodology Plan

4 CASE STUDY

4.1 Details
Following are the case study details collected. A site which are taken in to consideration is STARGAZE located in Bavdhan, west Pune zone, Maharashtra 411021. The designs and structural engineer teams is JW consultancy. Owner of this project is koltepatil. The architect of this project are Manoj tatuskar and VikasAcharikar. The cost of per flat starts forms 65 lakhs onwards. Total area of the project is 1.9 acre. The total cost of tower is 14cr.

Fig. 2. 3rd eye view of actual site

4.2 Site Details
- Name of sites: Stargaze
- Location of site: Bavdhan, West Pune zone, Pune, Maharashtra 411021
- Design Team: JW Consultancy
- Owner & Developer: KoltePatil
- Architect: Manoj Tatuskar & Vikas Acharikar
- Costs of flat: 64.4 Lakhs Onwards
- Structural Engineer: JW Consultant’s
- Builders: Kolte Patil
- Areas: 1.91 acre
- Residential building with No. of Towers: 6, Tower No. of Floors: 14 Floors, No. of Unit: 462 Units.
- This project is based upon sustainable structures
- Present condition of a project: Under construction
5 RESULTS AND DISCUSSION

In this thesis application of quality planning and factors affecting it like time, machine and material is studied for High rise structure. Stargaze project used effective replacement of material SA CLC bricks, Gypsum plaster to achieve quality. Machines such as Lift machines, Compactors, RMC mixers, cranes are used for time reductions in the WBS (work break down structure) which in turn resulted in achieving optimization of the time and resource involved in the project. The time was optimized by time optimization and resources, material was optimized by resource optimization in order to achieve the maximum efficiency.

5.1 Data Analysis

From the data collected the CAD drawings are taken into consideration and with respect to them the activities are derived which are then inserted in the MSP software according to its ascending order. Once this is done BBS (bar bending schedule) is prepared from working drawings the activities are listed out and a work breakdown structure is prepared. The important aspect of quality planning such as time, resources like machine and materials are the factors which act on the project according to the PMBOK.

Once the work break down structure is generated the activities are allotted with the time which is given to them according to the initial data and if required the days required are given a margin of days by which it could lag or lead which is called as lag or lead. In the MSP scheduling we can locate the total cost and time duration of the project with Quality planning checklist which is 952 days and Rs. 99,602,390.12.

![Fig. 3. Scheduling of the activities creating WBS](image)

5.2 Implementation of WBS for satisfying the quality of project

We have developed a job breakdown structure, which will be deployed on the Stargaze site. The primary goal of a work breakdown structure (WBS) is to simplify complex processes to collections of tasks. This is vital for the project manager since she can better supervise the duties than the complicated ones. Tasks must be quantifiable, independent, and with well-defined boundaries. All project work must be contained in at least one task, and no non-project work may be included in the tasks. Because the WBS activities are observable, project management may allocate exact expenditures to each one. The work breakdown structure (WBS) allows project managers to divide the project budget into specified packages connected to tasks and ensure that the overall cost of the tasks does not exceed the entire
project cost. We have incorporated quality checks to the WBS, which will add the cost and material resources that are necessary for the checking purpose correspondingly. When the connecting section of the activities is done, an excel sheet is created that contains the labour charge for materials such as cement, bricks, tiles, course aggregate, fine aggregate, CP fittings, mobilization materials, materials for watchman cabins, and so on. These resource sheets cover current market prices as well as labour expenses. The resource sheet is prepared based on the material, human resource, and their needs, which are determined by the BBS (bar bending schedule). The resource sheet is then loaded into the MSP programmer, and the resources are allotted to each activity.

While considering the elements affecting construction quality planning in relation to PMBOK, resources were allocated and time was optimized. The conventional brick, which had a length of 9cm, was replaced with SA CLC brick, which had a length of 120 cm, resulting in a time reduction because the area covered was maximum at a single time and the cement required for filling was less than the traditional method, and we could see the following changes in the time required for building construction. The plastering that is to be done twice or three times interior is to be replaced by the substance gypsum, in which the cost was lowered up to a specific level.

5.4 Critical success factor achievement

In the selected case study, the inclusion of milestones serves as a strategic indicator of our critical success factors (CSFs). These milestones represent pivotal points or achievements within the project timeline that directly align with our primary CSFs, including cost management, schedule adherence, quality assurance, scope definition, resource allocation, efficient work processes, and stakeholder satisfaction. By mapping these milestones to specific CSFs, we can track progress, identify potential challenges or deviations early on, and proactively address issues to ensure project success. Additionally, these milestones act as checkpoints for evaluating performance, enabling us to make data-driven decisions, allocate resources effectively, mitigate risks, and maintain alignment with project objectives and stakeholder expectations throughout the project lifecycle.

5.4.1 Milestone 1 – Substructure activities completed

- Cost: The total cost for the project "Stargaze with quality planning" is Rs. 99,602,390.12. This includes various components such as mobilization, substructure, and other activities. Cost is a critical factor because it directly affects the project's budget and financial success.
- Schedule: The project has a total duration of 952 days, starting from Thu 1/3/19 and ending on Mon 1/17/22. This includes different phases like mobilization, substructure, and so on. Schedule adherence is crucial to ensure timely completion of the project.
- Quality: Quality planning is emphasized in the project name and activities, indicating a focus on delivering a high-quality outcome. Activities like center line checking, footing casting, and others suggest attention to detail and quality assurance throughout the project.
- Scope: The scope of work includes mobilization, substructure activities, and possibly more phases not detailed here. Ensuring that the scope is well-defined and adhered to is essential for project success.
- Resources: The project requires various resources, including labor, materials, and equipment. Mobilization costs, for example, cover the expenses of setting up the necessary resources for the project.
- Work Process: The breakdown of activities like earthwork, PCC below footings, and footing casting indicates a structured work process. Each activity is clearly defined with its duration and cost, contributing to a systematic approach to project execution.
- Stakeholder Satisfaction: While not explicitly mentioned in the provided details, stakeholder satisfaction is a critical success factor. It involves meeting stakeholders'
expectations, communicating effectively, and addressing their concerns throughout the project lifecycle.

The project appears to have a well-planned approach, with specific activities, durations, and costs outlined. Critical success factors such as cost, schedule, quality, scope, resources, work process, and stakeholder satisfaction seem to be considered in the project execution. Achieving these factors likely involves careful planning, efficient resource management, adherence to schedules, and maintaining high-quality standards throughout the project.

5.4.2 Milestone 2- Shuttering levels checked
- Cost: The cost of each task is outlined in the data. For example, the cost for "Plinth column Shuttering" is Rs. 4,750.00 for 5 days. This CSF is achieved by accurately estimating costs, monitoring expenses, and ensuring that tasks are completed within budget.
- Schedule: The duration and start/end dates of each task determine the schedule. Tasks like "Plinth column Shuttering" have a duration of 5 days, starting on Mon 2/4/19 and ending on Fri 2/8/19. Adhering to these schedules ensures timely completion of the project.
- Quality: While the data does not explicitly mention quality, achieving quality in construction projects involves using the right materials, following standards and regulations, and ensuring workmanship. Tasks such as "Plinth Column Reinforcement" and "Plinth Beam Casting" are critical for ensuring structural integrity and quality.
- Scope: The scope of work is defined by the tasks listed. Each task contributes to the overall scope of the construction project, from excavation and foundation work to column and beam construction.
- Resources: Resources such as manpower, equipment, and materials are required for each task. For example, tasks like "Plinth Column Reinforcement" and "Footing Excavation Filling" require specific resources to be completed.
- Work Process: Each task follows a specific work process or methodology. For instance, tasks like "Plinth Column Casting" and "Compaction" require specific techniques and procedures to be followed.
- Stakeholder Satisfaction: Satisfying stakeholders involves meeting their expectations regarding cost, schedule, quality, and scope. By achieving the other CSFs, stakeholder satisfaction can be ensured.

Based on the provided data, these CSFs are achieved through careful planning, monitoring, and execution of each task in the construction project.

5.4.3 Milestone 3- Slab work done
- Cost: The cost factor is reflected in the budget allocated for each task. The budget for each task is specified, and the total cost of the superstructure is provided as Rs. 97,459,045.12.
- Schedule: The schedule factor is indicated by the duration of each task. The duration is given in days or in a date range. For example, the 1st Slab task took 18.53 days, and the overall superstructure task lasted 861 days.
- Quality: The quality factor can be inferred from the mention of specific requirements, such as maintaining concrete cover around reinforcement steel as specified. The completion of each slab with specified requirements indicates adherence to quality standards.
- Scope: The scope factor is not explicitly stated in the provided data. However, the completion of each slab and other tasks suggests progress in achieving the overall scope of the project, which includes the construction of the underground water tank, checking water leakage, and the superstructure.
- Resources: Resources refer to the materials, equipment, and labor required for the project. The budget allocated for each task can indicate the resources allocated. Additionally, the duration of each task can provide insight into resource utilization efficiency.
• Work Process: The work process factor is related to how effectively tasks are planned, executed, and monitored. The completion of each task within the specified duration suggests effective work processes.
• Stakeholder Satisfaction: Stakeholder satisfaction is not directly measured in the provided data. However, completing tasks within budget and schedule while maintaining quality can contribute to stakeholder satisfaction.
• In summary, based on the provided data, the critical success factors (CSFs) for the construction project appear to have been achieved through effective management of cost, schedule, quality, resources, and work processes. Stakeholder satisfaction, while not directly measured, can be inferred from the successful completion of the project milestones.

5.4.4 Milestone 4- Brickwork done
• Cost: The total cost for the brickwork is Rs. 6,878,400.00. This indicates that cost management was important, and the project seems to have stayed within budget.
• Schedule: The brickwork started on Thu 4/18/19 and finished on Thu 4/15/20, taking 311 days. The schedule seems to have been closely followed, with specific durations allocated for each floor and the parapet wall.
• Quality: The alignment, camber, level, and plumb (verticality) were maintained during brickwork, as indicated by the additional Rs. 800.00 cost for each instance. This suggests a focus on maintaining quality standards.
• Scope: The scope appears to have been well-defined, with specific tasks allocated for each floor and the parapet wall, and no deviations or additional tasks noted.
• Resources: The resource allocation for the brickwork appears to have been sufficient, as indicated by the completion of each floor and the parapet wall within the allocated time and budget.
• Work Process: The work process, including the alignment, camber, level, and plumb (verticality) maintenance, seems to have been well-structured and followed consistently throughout the brickwork.
• Stakeholder Satisfaction: The completion of the brickwork within the scheduled time and budget, and the maintenance of quality standards, suggests that stakeholders, such as the project owner, architect, and residents, are likely to be satisfied with the outcome.

5.4.5 Milestone 5- Plastering work done
• Cost: The total cost for plastering is Rs. 1,892,829.44, which includes both internal and external plastering. Cost can be considered a success if it is within the budgeted amount. In this case, the cost seems to be within the planned budget, but further analysis comparing the actual cost against the budgeted cost is necessary for a definitive assessment.
• Schedule: The schedule for each task is provided in terms of days taken to complete the work. Tasks like plastering, plumbing, and sanitary work have varying durations. Schedule success would depend on whether the work was completed within the planned time frame. For example, the plumbing and sanitary work took 357.16 days, which is within the expected duration.
• Quality: The data does not provide explicit information about the quality of the work. However, quality can be inferred from factors such as adherence to standards, absence of rework, and customer satisfaction. Stakeholder feedback or inspection reports would be needed to assess the quality of the work.
• Scope: The scope of work includes internal and external plastering, plumbing, and sanitary work. Scope success would mean completing all tasks as per the defined scope without any omissions or additions. From the data, it appears that the defined scope of work was completed.
Resources: Resources such as labor, materials, and equipment are required for the tasks. The data does not provide detailed information on resource utilization, but successful resource management would involve using the right resources in the right quantities at the right time to complete the work efficiently.

Work Process: The work process refers to the methods and procedures used to complete the tasks. Successful work processes would be efficient, effective, and compliant with regulations and standards. The data does not provide specific details on the work process, so further information would be needed to assess this factor.

Stakeholder Satisfaction: Stakeholder satisfaction is crucial for project success. It can be inferred from factors such as meeting stakeholder expectations, addressing their concerns, and timely communication. In the absence of explicit data on stakeholder satisfaction, it is challenging to assess this factor accurately.

In summary, based on the provided data, the critical success factors for the brickwork tasks appear to be achieved to some extent, but a comprehensive analysis including actual versus planned metrics and stakeholder feedback would provide a more accurate assessment.

5.4.6 Milestone 6- External plumbing completed

Cost: The total cost for external plumbing was Rs. 1,246,000.00, which seems to be within the budget as there is no mention of exceeding the allocated amount. This suggests that the cost factor was managed successfully.

Schedule: The external plumbing was completed within the planned duration of 55 days, starting from Mon 4/6/20 and ending on Tue 6/9/20. Each task was completed within its specified timeframe, indicating successful management of the schedule.

Quality: The data does not explicitly mention the quality of the external plumbing work. However, the successful completion of the project without any mention of rework or quality issues suggests that the quality standards were likely met.

Scope: The scope of the external plumbing project appears to have been well-defined, as evidenced by the breakdown of tasks and their completion. The completion of all planned tasks indicates that the project scope was successfully managed.

Resources: The resource allocation for the external plumbing project, including manpower, materials, and equipment, appears to have been adequate. This is indicated by the successful completion of the tasks within the planned duration and budget.

Work Process: The work process for the external plumbing project seems to have been well-organized and efficient, as evidenced by the completion of tasks within their specified durations. This suggests that the work process was successful in achieving the project objectives.

Stakeholder Satisfaction: While the data does not provide explicit information about stakeholder satisfaction, the successful completion of the external plumbing project within the planned cost, schedule, and scope is likely to have contributed to stakeholder satisfaction. However, direct feedback from stakeholders would be needed to confirm this.

5.4.7 Milestone 7- Electrical work completed

Cost: The total cost for electrical work was Rs. 5,162,550.00, which was within the budget allocated for this task. This indicates that cost management was successful.

Schedule: The electrical work was completed in 653.47 days, from Fri 6/7/19 to Thu 7/8/21. While this exceeded the initial estimate, it's important to note that the project was completed within a reasonable timeframe.

Quality: The completion of tasks such as conduits in slabs, wall conduiting inside flats, fixing of DB box, laying of wiring, fixing of switches, etc., suggests that the work was done according to quality standards and specifications.
• Scope: The scope of work, including conduits, wiring, switch fixing, and other electrical installations, was clearly defined and all tasks were completed as planned, indicating successful scope management.
• Resources: Resources, including labor, materials, and equipment, were effectively utilized to complete the electrical work within the specified budget and schedule.
• Work Process: The work process, as evidenced by the completion of tasks in a sequential and timely manner, was managed efficiently, leading to the successful completion of the electrical work.
• Stakeholder Satisfaction: The completion of the electrical work indicates that stakeholders, including the project team, contractors, and clients, were satisfied with the outcome, as the project met its objectives within the specified constraints.
Overall, the critical success factors for the electrical work milestone were achieved through effective cost management, adherence to schedule, maintaining quality standards, fulfilling the scope of work, efficient resource management, well-managed work processes, and ensuring stakeholder satisfaction.

5.4.8 Milestone 8- Water proofing
• Cost: The total cost for waterproofing was Rs. 2,314,900.00, which was within the budget allocated for this task.
• Schedule: The waterproofing task was completed in 260.19 days, starting from Tue 6/25/19 and ending on Thu 4/23/20, which appears to be within the planned schedule.
• Quality: The quality of the waterproofing work is not explicitly mentioned in the data provided, so it's assumed that it met the required standards.
• Scope: The scope of the waterproofing work covered all floors of the building, as indicated by the separate tasks for each floor.
• Resources: The resources allocated for waterproofing, including materials and labor, were effectively managed to complete the task within the specified budget and schedule.
• Work Process: The work process for waterproofing, including planning, execution, and monitoring, was likely well-organized and followed to achieve the desired outcome.
• Stakeholder Satisfaction: Since there are no specific indicators of stakeholder satisfaction in the provided data, it's assumed that stakeholders were satisfied with the completion of the waterproofing task within the budget and schedule.
Overall, based on the given data, it appears that the primary CSFs for milestone 8 (Waterproofing) were achieved satisfactorily, with the task being completed within budget and schedule, covering the scope, and likely meeting quality standards.

5.4.9 Milestone 9- External and internal paint work done
• Cost: The total cost for flooring, internal painting, and external painting is within budget, indicating that cost was managed effectively. No cost overruns were reported.
• Schedule: The schedule for each task was meticulously planned and executed. The duration for each floor's painting and other tasks was adhered to, ensuring that the project was completed on time.
• Quality: The quality of the work is not explicitly mentioned in the provided data. However, assuming that the work met or exceeded the company's specifications and industry standards, we can infer that quality was achieved through proper planning and supervision.
• Scope: The scope of work, which included flooring, internal painting, and external painting, was clearly defined and completed as planned. There were no mentions of additional scope creep or changes to the original scope.
• Resources: The resources required for each task, including materials and labor, were effectively managed. The allocation of resources was sufficient to meet the project's requirements without excessive waste or shortages.
• Work Process: The work processes for each task, such as checking the quality of materials, painting each floor, and completing external painting, were well-defined and followed. This ensured that work was completed efficiently and according to standards.
• Stakeholder Satisfaction: While stakeholder satisfaction is not explicitly mentioned, completing the project on time and within budget likely contributed to stakeholder satisfaction. Additionally, if stakeholders were involved in decision-making or kept informed throughout the project, their satisfaction may have been further ensured.
Overall, the achievement of milestone 9 was likely due to effective management of cost, schedule, quality, scope, resources, work process, and stakeholder satisfaction throughout the project.

5.4.10 Milestone 10- Railing fixed
• Cost: The cost for the MS Railing for Staircase was Rs. 174,500.00, and there were no additional costs mentioned for fixing the railing. Therefore, the cost factor was achieved within the allocated budget.
• Schedule: The task of fixing the railing started on Sat 6/19/21 and was completed on Mon 11/22/21, taking 260 days. This indicates a delay in schedule as the task was planned for 133 days. The delay might have been due to various reasons like material availability, labor constraints, or other unforeseen circumstances.
• Quality: The quality of the work can be assumed to be satisfactory since there are no specific indicators of poor quality mentioned in the data. However, without additional information or inspection, it is challenging to make a definitive assessment.
• Scope: The scope was to fix MS railing for the staircase, and this was achieved as per the task description. There are no mentions of additional scope beyond this task.
• Resources: The resources required for fixing the railing were not explicitly mentioned in the data. Assuming that the necessary resources such as labor, materials, and equipment were available, this factor can be considered achieved.
• Work Process: The work process for fixing the railing was not detailed in the data provided. Assuming that the work was carried out following standard procedures, this factor can be considered achieved.
• Stakeholder Satisfaction: There is no specific mention of stakeholder satisfaction in the data. Assuming that the stakeholders (project managers, clients, etc.) were satisfied with the outcome, this factor can be considered achieved.
Overall, while the cost and scope were achieved, there was a significant delay in schedule, which might have impacted other factors like resources and stakeholder satisfaction. It's important to analyze the reasons for the delay to prevent similar issues in future projects.

5.4.11 Milestone 11- Lift work done with all remaining part
• Cost: The cost for lift work was Rs. 3,051,200.00, and it was completed within the allocated budget. This indicates that the cost CSF was achieved.
• Schedule: The lift work took 861 days, starting from Thu 4/18/19 and ending on Mon 1/17/22. While this seems to have exceeded the initial schedule, without additional context it's hard to determine if this impacted the overall project schedule or if it was within an acceptable deviation.
• Quality: There is no specific information provided regarding the quality of the lift work. To determine if this CSF was achieved, we would need more details on the quality standards and any quality control measures that were implemented.
• Scope: The completion of lift work with all remaining parts suggests that the scope of work was fulfilled as planned, indicating that this CSF was achieved.
• Resources: The resources utilized for the lift work, such as labor, materials, and equipment, are not detailed. Without this information, it's difficult to assess if the resource CSF was achieved.
• Work Process: The work process for the lift work, including any methodologies or workflows used, is not provided. Without this information, it's challenging to evaluate if the work process CSF was achieved.
• Stakeholder Satisfaction: There is no direct information provided on stakeholder satisfaction. To determine if this CSF was achieved, feedback from stakeholders involved in or affected by the lift work would be necessary.

Overall, based on the provided data, it appears that the lift work was completed within the allocated budget and scope, but there are gaps in information regarding schedule adherence, quality, resource utilization, work processes, and stakeholder satisfaction that would require additional context to fully evaluate.

6 CONCLUSION

Research findings and on-site investigations underscore the critical need for robust quality planning in the construction realm. Quality planning, a cornerstone of ensuring excellence in construction projects, hinges on factors such as time, machinery, and materials, as delineated in the PMBOK framework. The application of these quality planning principles has been meticulously addressed in this thesis, with a specific focus on the current case study. Notably, the standards referenced in PMBOK, namely ISO 9000, set the benchmark for quality assurance. The stipulated timeframe for the completion of this case study stands at 952 days, with a corresponding budget of Rs. 99,602,390.12.

Despite its utility in scheduling, budget management, and resource allocation, MS Project falls short in gauging stakeholder satisfaction and comprehensively understanding workflow dynamics. This deficiency can be attributed to various factors. MS Project primarily emphasizes quantitative aspects and lacks the nuanced capabilities required for gathering and analyzing qualitative stakeholder feedback. Stakeholder satisfaction, being inherently subjective, demands a nuanced approach that MS Project currently lacks. Moreover, stakeholders' perspectives and satisfaction levels are dynamic, posing challenges to maintaining accurate and up-to-date records over time. Consequently, project managers may need to supplement MS Project with additional tools or methodologies, such as surveys, interviews, or specialized stakeholder management software, to effectively capture and manage stakeholder satisfaction data.

These limitations impede a comprehensive assessment of project performance beyond conventional success metrics. Addressing this issue requires exploring future avenues, such as integrating stakeholder management tools to monitor satisfaction levels and leveraging process mining techniques for in-depth workflow analysis. Additionally, broadening the scope of critical success factors to include environmental impact, community engagement, and ethical considerations could enhance project evaluation and promote sustainable practices. Incorporating these dimensions into project management software would afford a more holistic view of project success, empowering stakeholders to make informed decisions.
7 REFERENCES


6) Tran, Tuan, Kiet., Truong, Cong, Thuan., Tran, Thi, Kha. (2022). Proposing solutions to reduce factors affecting the delay of construction phase in high-rise building projects. 2(2):34-36. doi: 10.26480/jtin.02.2022.34.36