CHAPTER 22

Assessment of Critical Success Factors for a Project Delivery

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ABSTRACT

A critical success factor (CSF) in construction projects refers to key elements, conditions, or activities that are essential for achieving the successful completion of a project. These factors directly influence the project's ability to meet its objectives, such as delivering on time, within budget, and to the required quality and safety standards, while satisfying stakeholder's expectations. In essence, CSFs are the core aspects that must be managed effectively to ensure a project success. The list of Critical Success Factors (CSFs) was determined through an extensive review of literature surveys. The most essential factors were identified based on their recurrence across multiple projects and their significant impact on success rates. These factors were then weighted accordingly. To validate the shortlisted CSFs, a questionnaire survey was designed, and inputs were collected from industrial experts, leveraging their experiences from current and past projects. The responses were analysed to confirm the prominence of the shortlisted CSFs. A school building project was selected as a case study to further verify these factors. The identified CSFs were found to align closely with those shortlisted earlier, reaffirming their relevance and importance.

Keywords: Critical success factors; Project delivery; School building project; Project success; Success rates.

1.0 Introduction

The critical success factors (CSFs) for construction projects in India have evolved over time, influenced by the nation's historical, cultural, and economic development. In the post-independence era, large-scale infrastructure projects like dams, roads, and urban development were driven by public sector initiatives, emphasizing government funding, skilled labor, and efficient planning. Over the decades, technological advancements, regulatory reforms, and global influences have shaped the construction industry, introducing modern management practices and sustainable approaches. Factors such as effective project planning, stakeholder coordination, adherence to timelines and budgets, quality control, risk management, and compliance with legal and environmental standards have become increasingly crucial.

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DOI: 10.17492/JPI/NICMAR/2507022 *ISBN: 978-93-49790-54-4*

Additionally, the integration of technology, skilled workforce development, and robust supply chain management have gained prominence as India transitioned into a more urbanized and industrialized economy. Today, fostering innovation, addressing land acquisition challenges, and ensuring community engagement remain essential for the success of construction projects in the country. In the construction industry, the successful completion of a project is determined by a variety of factors, which must be carefully managed to ensure the project meets its objectives. Critical Success Factors (CSFs) refer to the essential areas of activity or elements that must be performed well to achieve the desired outcomes. Understanding these factors is crucial for project managers, contractors and other stakeholders involved in construction projects. Construction projects are complex endeavours, often involving multiple parties, tight budgets, strict timelines and a variety of technical and regulatory challenges. As such, the identification and management of CSFs help mitigate risks and increase the likelihood of project success. CSFs vary depending on the nature of the project, its size, location, and scope, but common factors are applicable across most construction endeavours.

2.0 Literature Review

Analyzed Critical success factors (CSFs) in building projects in India, emphasizing stakeholder interaction, planning, and efficient resource management. In order to increase project success, the study found that multi-stakeholder tactics were necessary (Kumar *et al.*, 2023). Practitioners suggest that, in addition to cost, time, and quality, elements such as risk management, environmental concerns, and client relationships are critical for construction management. (Kumar *et al.*, 2023). Project success is increased by planning, early standardization, and controlled execution, according to CSFs for facility design standardization in capital projects, especially in the oil and gas sector. (Choi *et al.*, 2020). Studied how capital project performance is enhanced by following design standardization CSFs. According to the study, stakeholder involvement and disciplined procedures lead to increased efficiency and cost savings (Shrestha *et al.*, 2020).

Developed key performance indicators (KPIs) for large-scale building projects, classifying success according to social effect, innovation, efficiency, stakeholder satisfaction, and strategic alignment (He *et al.*, 2020). Investigated project complexity in Chinese construction projects and came to the conclusion that high degrees of complexity have an adverse impact on project success, especially when it comes to information flow and goal alignment. (Negash *et al.*, 2020). Examined the effects of using big data in building projects and determined the elements that affect the utilization of it, including technological preparedness, management support, and team experience (Yu *et al.*, 2020).

Investigated how team behaviors affect client satisfaction in building projects, focusing the value of team empowerment, planning, coordination, and contractor assurance (Nguyen *et*

DOI: 10.17492/JPI/NICMAR/2507022 *ISBN: 978-93-49790-54-4*

al., 2019). In Public-Private Partnership (PPP) megaprojects, key elements influencing financial and completion risk include governance, risk allocation, and finance arrangements (Owolabi *et al.*, 2019). Determined the success criteria for Chinese construction projects, with a strong emphasis on social harmony, stakeholder management, and alignment with strategic goals (Yan *et al.*, 2019). Studied stakeholder management in long-term megaprojects, stressing proactive communication, adaptation, and strategic engagement to maintain project stability (Park *et al.*, 2017). Analyzed the elements that influence the effectiveness of modular construction projects in the industrial sector, highlighting vendor involvement, risk management, and early design alignment (Choi *et al.*, 2016). The study evaluated the relationship between project complexity and success in Chinese construction projects and concluded that controlling complexity through organized planning and clear communication enhances outcomes (Luo *et al.*, 2016). CSFs for Enterprise Resource Planning (ERP) implementation in Turkey's construction industry, with a focus on management support, clear goals, and team competence (Ozorhon *et al.*, 2015). Investigated Critical success factors for effective Building Information Modeling (BIM) implementation and discovered that interoperability, training, and trust are required for collaborative success (Shang *et al.* 2014).

Investigated CSFs in the construction project briefing process, emphasizing the significance of clear client needs, good stakeholder engagement, and structured communication (Yu *et al.*, 2013). Assessed the impact of Project Management Body of Knowledge (PMBOK) principles on construction success in Taiwan, Indonesia, and Vietnam, and found a positive relationship (Chou *et al.*, 2013). We compared two transportation megaprojects (in the United States and Mexico) and identified early planning, stakeholder alignment, and risk management as critical success factors (Lopez del Puerto *et al.*, 2013). The study examined the human factors in building performance and discovered that leadership, team dedication, and systematic project monitoring increase project outcomes (Tabish *et al.*, 2012).

The Analytical Hierarchy Process (AHP) was used to identify the most significant CSFs in construction, with the conclusion that project manager skill and comprehensive planning are important (Kog *et al.*, 2012). Investigated stakeholder management in construction projects, emphasizing the significance of social responsibility and proactive stakeholder participation (Yang *et al.*, 2010). The effects of construction project briefing on success, with the conclusion that excellent communication, documentation, and stakeholder involvement are critical (Yu *et al.*, 2006). Investigated success and failure variables in Web-based Project Management Systems (WPMSs), identifying project characteristics, system features, and team dynamics as significant effects. (Nitithamyong *et al.*, 2006). Factors influencing schedule performance in Indian construction, concluding that project management skill, owner involvement, and favourable conditions all effect completion times (Iyer *et al.*,2006).

Established a conceptual framework for CSFs in construction, including project scope, procurement procedures, and human factors as main contributors (Chan *et al.*, 2004). Focused on value management in construction, with client support, clear objectives, and

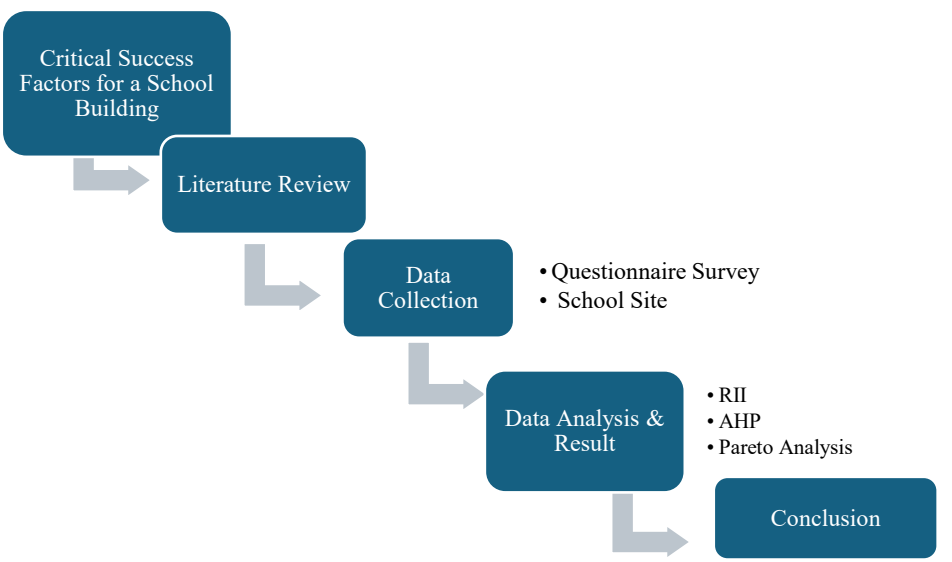
DOI: 10.17492/JPI/NICMAR/2507022 *ISBN: 978-93-49790-54-4*

multidisciplinary teamwork as critical success factors for optimizing project resources (Shen *et al.*, 2003). Developed a quantitative tool for quantifying construction success that includes cost growth, schedule adherence, quality, and safety indicators (Shields *et al.*, 2003). CSFs for building projects were identified using expert judgment, with economic risks, funding adequacy, and site limits being important issues (Chua *et al.*, 1999). Successful construction projects must integrate financial, managerial, and technical developments while maintaining good communication and risk mitigation.

3.0 Methodology

The primary objective of this study was to identify and prioritize the critical success factors (CSFs) that significantly influence the successful delivery of construction projects. Figure 1 shows methodology of study. Questionnaire is circulated among industry professionals, including project managers and engineers, to validate our findings and capture additional factors that reflect current practices and challenges in the field. The questionnaire was quantitative ratings on the importance of each identified factor. 5-point Likert scale, allowing respondents to indicate their perceptions, ranging from 1 (least important) to 5 (most important. Their feedback proved invaluable, enabling us to refine the questionnaire for clarity and effectiveness before finalizing it. Ultimately, we earned 44 completed surveys, which formed the basis of our analysis. Subsequently, we moved into the calculation of the RII for each factor. Employing the formula:

Figure 1: Methodology Flowchart



DOI: 10.17492/JPI/NICMAR/2507022 *ISBN: 978-93-49790-54-4*

$$RII = \frac{\Sigma W}{A \times N} \quad \ldots 1$$

Here, equation no (1) shows, ΣW represents the total weight assigned by respondents, A is the maximum score possible on our scale (5 in this case), and N denotes the total number of respondents. Once the RII values were calculated, we ranked the factors in descending order to determine their relative importance to project success. In addition, the Analytic Hierarchy Process (AHP) was applied as a complementary analytical tool to validate the insights garnered from the RII calculations. AHP provides a structured framework for evaluating multiple factors and their interrelations. AHP Steps include:

1. *Define the goal:* Clearly state what decision you need to make.
2. *List criteria & alternatives:* List the factors (criteria) that affect the decision and the options (alternatives) to choose from.
3. *Pairwise comparisons:* Compare criteria and alternatives two at a time using 1–9 scale to judge importance.
4. *Calculate weights:* Normalize the comparisons to find priority values.
5. *Check consistency:* Ensure the comparisons are logically consistent (CR < 0.1).
6. *Find best option:* Multiply weights, rank alternatives, and pick the best one.

The integration of both RII and AHP fortified our findings and facilitated the development of actionable recommendations that project managers and organizations can implement to enhance project performance. In addition to this, Pareto Analysis was also done to get the most impactful Critical Success Factors.

4.0 Data Analysis and Result

A total of 44 people responded to the survey across various positions in the construction industry. The gathered data from the questionnaire survey was analysed using RII and the following results were obtained (see table no.1)

4.1 Relative importance index

The RII analysis revealed that strong communication and collaboration is the most critical factor for project success, followed by adequate budgeting and financial management and quality management and standards compliance. These findings align with the broader understanding in the construction industry that effective communication, financial control, and adherence to quality standards are foundational to achieving project objectives. Other factors, such as clear scope and objectives, risk management, and modern technology, also ranked highly, indicating their importance in ensuring project success.

4.2 Analytic hierarch process

To further validate the findings, the Analytic Hierarchy Process (AHP) was applied. The AHP-based ranking confirmed the prominence of strong communication, budgeting, and

DOI: 10.17492/JPI/NICMAR/2507022 *ISBN: 978-93-49790-54-4*

quality management, with these factors receiving the highest priority weights. This consistency between the RII and AHP results underscores the reliability of the findings and highlights the need to prioritize these factors in construction project management. Based on the AHP analysis using the RII rankings, Table no.2 shows the top-ranked CSFs with their respective priority weights are:

Table 1: Relative Importance Index

Factor	Ranking
Strong communication and collaboration	1
Adequate Budgeting and Financial Management	2
Quality Management and Standards Compliance	3
Modern Technology and Innovation	3
Skilled and Experienced Project Team	5
Client Satisfaction	6
Contractual Agreements and Legal Frameworks	7
Planning and Scheduling	8
Strict Compliance with HSE	9
Clear Scope and Objective	10
Risk Management and Contingency Planning	10
Supply Chain and Material Management	10
Site Management and Logistics	14
Effective Stakeholder Management and Engagement	15
Cultural and Organizational values	16

Table 2: AHP Weights for the Top 5 Critical Success Factors

Critical Success Factors	Priority Weights
Strong communication and collaboration	45.80%
Adequate Budgeting and Financial Management	24.40%
Quality Management and Standards Compliance	13.70%
Modern technology and innovation	8.80%
Skilled and experienced project team	7.30%

4.3 Pareto analysis

A Pareto analysis was also conducted to identify the most impactful CSFs. 80/20 rule, suggesting that focusing on the top 20% of CSFs such as communication, budgeting, and quality management can yield the most significant impact on project success. The orange line represents the cumulative percentage, while the 80% threshold helps identify the most impactful CSFs as shown in Figure 2.

DOI: 10.17492/JPI/NICMAR/2507022 *ISBN: 978-93-49790-54-4*

Figure 2: Pareto Analysis

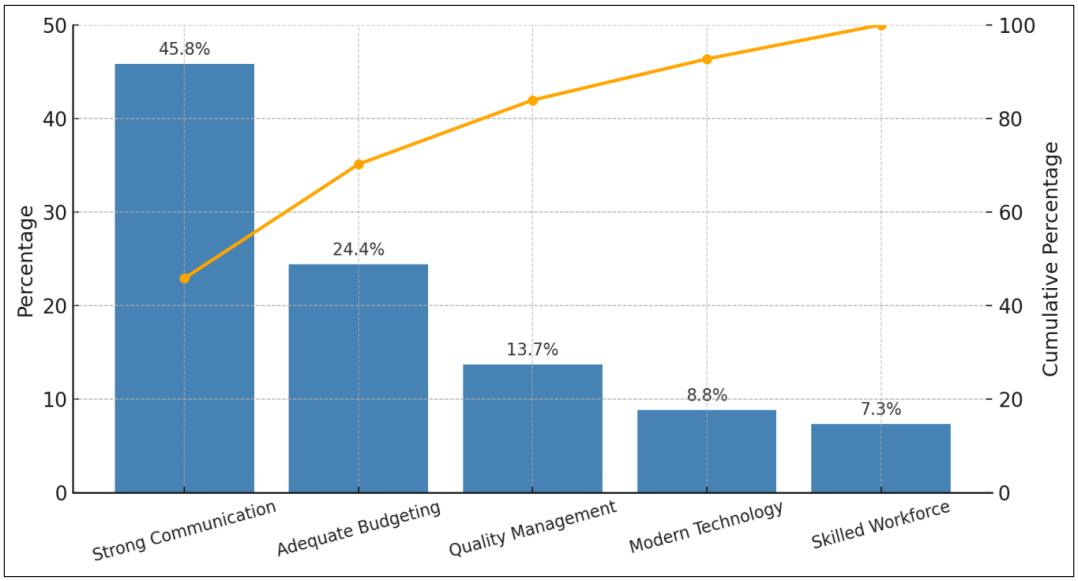


Table 3: Critical Success Factors Identified on Site

Sr. No	Factors	Issues	Mitigation Measures
1	Project Planning	Cost overrun due to less anticipated quantity of work.	Worked out the total actual quantity of work and revised the estimate for future use.
		Schedule Overrun due to multiple revisions of drawings and causing reworks.	Effectively studying drawings and analysis it prior to any commencement of actual work.
2	Effective Communication	Delay in arranging samples for approval to client by management and also delay caused by client in the process of selecting the required materials.	Communicating with stakeholders and getting clarity about desired make and shade of materials.
3	Risk Management	Unforeseen site conditions leading to delays.	Conducting thorough site surveys and risk assessments before project initiation.
4	Supply Chain Management	Delays in material delivery affecting project timelines.	Establishing reliable supplier contracts and maintaining buffer stock for critical materials.
5	Stakeholder Engagement	Misalignment of expectations between stakeholders.	Regular stakeholder meetings and clear documentation of project goals and deliverables.
6	Skilled and experienced project team	Labour shortages or unskilled labour impacting productivity.	Implementing training programs and ensuring proper workforce planning and allocation.

DOI: 10.17492/JPI/NICMAR/2507022 *ISBN: 978-93-49790-54-4*

4.4 Site data

A school building project was selected as a case study to further verify these Critical Success Factors gathered from Literature Review and Questionnaire survey. Table 3 shows the Factors affected the successful completion of the project with issues and their mitigation measures taken on site to overcome it. The site data highlights common challenges such as cost overruns, schedule delays, communication bottlenecks, and workforce issues, which are often encountered in construction projects. To address these issues, the study proposes practical mitigation measures, including revising estimates, conducting thorough risk assessments, improving stakeholder communication, ensuring efficient supply chain management, and investing in workforce training. These strategies aim to minimize risks and enhance project performance.

5.0 Conclusion and Recommendation

The analysis of Critical Success Factors (CSFs) in construction projects underscores the importance of strong communication, adequate budgeting, and quality management as the most critical drivers of project success. The findings, validated through both RII and AHP methods, emphasize the need to prioritize these factors to achieve project objectives efficiently. Additionally, the Pareto analysis highlights the 80/20 rule, suggesting that focusing on the top 20% of CSFs can yield the most significant impact on project outcomes. The site data further reinforces the practical relevance of these findings, identifying common issues such as cost overruns, schedule delays, communication challenges, and workforce management problems. By implementing the proposed mitigation measures—such as improved planning, risk management, stakeholder engagement, and workforce training—construction teams can address these challenges effectively and enhance project performance. The successful completion of construction projects is dependent on a careful balance of adequate budgeting, and quality management, technical expertise, effective communication, and adaptive management method. By prioritizing the identified CSFs and implementing the recommended mitigation strategies, construction teams can enhance project performance, minimize risks, and achieve stakeholder satisfaction. Future research should focus on developing context-specific CSF models and exploring the evolving role of sustainability, innovation, and technology in shaping the future of construction project management. This study serves as a valuable resource for project managers and construction professionals seeking to improve project delivery and achieve successful outcomes in an increasingly dynamic industry.

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