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CONSTRUCTION DELAY OPTIMIZATION

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ABSTRACT

Construction delays have long been a formidable challenge in the civil engineering and infrastructure development sectors, leading to substantial financial burdens, legal disputes, and inefficiencies in project execution. These delays are inherently multifaceted, stemming from inadequate project planning, labour force deficiencies, fluctuating material availability, and unforeseen environmental or regulatory constraints. The repercussions extend beyond economic setbacks, disrupting stakeholder confidence, delaying infrastructural benefits, and undermining investor trust in large-scale developments. This research thoroughly investigates the primary causes of construction delays, specifically in stilt-type framed structures, through a robust combination of qualitative insights from industry experts and quantitative data from real-world project analysis. By categorizing delays into key domains—material procurement inefficiencies, workforce productivity challenges, recurrent design modifications, and external disruptions—this study elucidates practical strategies for mitigating these impediments. The findings emphasize the necessity of advanced project scheduling methodologies, proactive risk management, enhanced stakeholder coordination, and optimized supply chain logistics to fortify project execution. Furthermore, the adoption of lean construction principles, real-time monitoring systems, and digital workflow optimization tools is proposed as an integrated approach to improving efficiency, minimizing disruptions, and ensuring seamless project completion. This study contributes significantly to construction management literature by presenting empirical, data-driven solutions that industry practitioners can implement to substantially reduce delays, enhance operational efficiency, and achieve superior project outcomes.

Keywords – Construction delays, Project scheduling, Risk management, Labor productivity, Regulatory constraints, Design modifications, Operational efficiency, Cost overrun.

I. INTRODUCTION

The construction industry is a fundamental driver of economic development and urban transformation. It plays a pivotal role in shaping modern infrastructure, supporting industrial growth, and enhancing societal progress. However, the industry is plagued by a chronic issue, project delays that significantly undermine efficiency, financial stability, and stakeholder confidence. These delays often result in cost overruns, extended project durations, and disputes between contractors, clients, and regulatory bodies. The implications extend beyond monetary losses, affecting structural quality, environmental sustainability, and the overall credibility of the industry.

Construction delays arise due to a multitude of interconnected factors, including mismanagement of resources, scheduling inefficiencies, inadequate workforce productivity, and external influences such as regulatory constraints and adverse weather conditions. Addressing these delays requires a structured approach that identifies the root causes, assesses their impact, and implements targeted solutions to enhance project delivery efficiency.

II. PROBLEM STATEMENT

Delays in construction projects are a persistent global challenge, but their impact is particularly severe in developing economies where financial and infrastructural constraints exacerbate project inefficiencies. Poor planning, resource shortages, frequent design alterations, and unforeseen environmental and administrative hurdles contribute to substantial project disruptions. Despite advancements in project management methodologies, delays continue to hamper construction timelines, leading to cascading financial and legal implications.

The repercussions of these delays are multifaceted, affecting not only project owners and contractors but also investors, end-users, and regulatory institutions. Delayed infrastructure projects can lead to increased operational costs, reduced investor confidence, and economic stagnation. Thus, understanding the underlying causes of these delays is imperative to developing effective mitigation strategies that can ensure timely and cost-efficient project completion.

III. RESEARCH GAP

While extensive research has been conducted on construction delays, existing studies often focus on isolated factors rather than providing a comprehensive, integrated analysis of the issue. Additionally, many studies emphasize technical and managerial solutions while neglecting the socioeconomic and environmental dimensions of construction delays. There remains a significant gap in developing a holistic framework that synthesizes empirical data, stakeholder perspectives, and advanced risk mitigation methodologies. This study aims to bridge this gap by systematically categorizing the primary causes of construction delays using empirical data and case studies, analysing the financial, operational, and legal consequences of these delays on various stakeholders, and investigating proactive mitigation techniques such as risk management models, process optimization, and policy-driven interventions. Furthermore, the research provides actionable recommendations for improving scheduling, optimizing resource utilization, and enhancing collaboration among stakeholders to achieve more efficient and sustainable construction project execution.

IV. OBJECTIVES OF THE STUDY

The primary objectives of this research are to systematically identify and classify the critical factors contributing to construction project delays, providing a structured understanding of the root causes that hinder timely project completion. Additionally, the study aims to assess both the short-term and long-term financial, operational, and legal repercussions of these delays, highlighting their broader impact on project stakeholders. Another key objective is to evaluate the effectiveness of existing mitigation strategies in minimizing delays, examining their practical applicability and limitations. Finally, this research seeks to propose an integrated framework for reducing construction delays through enhanced planning methodologies, optimized resource management, and strengthened stakeholder engagement, ensuring a more efficient and resilient project execution process.

V. INDUSTRY RELEVANCE

The findings of this study hold substantial significance for the construction sector, particularly in developing economies where project delays are a persistent challenge due to workforce shortages, financial constraints, and bureaucratic inefficiencies. By systematically analysing the underlying causes and consequences of these delays, this research offers practical insights that can drive more efficient project execution.

The insights derived from this study provide tangible value to multiple stakeholders within the industry. Project managers and contractors can leverage the findings to implement effective strategies aimed at minimizing inefficiencies, optimizing scheduling, and improving overall project performance. Regulatory authorities stand to benefit from data-driven recommendations that facilitate streamlined approval and compliance processes, reducing unnecessary bureaucratic bottlenecks. Additionally, investors and developers can gain a more comprehensive understanding of risk management strategies, enabling them to make informed decisions and mitigate potential financial losses associated with project delays.

By addressing the core challenges associated with construction delays, this research contributes to the broader discourse on sustainable construction management. It fosters the development of a more resilient and adaptive construction industry, one that is better equipped to navigate uncertainties, enhance efficiency, and deliver projects within the stipulated timeframe and budget.

VI. IMPORTANCE OF CONSTRUCTION DELAY OPTIMIZATION

ECONOMIC IMPACT

Construction project delays impose substantial financial burdens due to escalated costs, inefficient resource utilization, and contractual penalties. These financial setbacks not only diminish project profitability but also hinder broader economic growth by delaying infrastructure availability and investment returns. Addressing these delays is critical to maintaining financial viability within the industry and ensuring sustained economic development.

TIMELY INFRASTRUCTURAL DEVELOPMENT

As urbanization accelerates and global infrastructure demands rise, timely project execution becomes essential for economic progress and public welfare. Delays in critical infrastructure projects—such as transportation networks, utilities, and housing—can stall urban expansion and disrupt essential services. Optimizing delays enhances project efficiency, ensuring the timely delivery of infrastructure necessary for societal advancement.

STAKEHOLDER SATISFACTION

Frequent project delays strain relationships between key stakeholders, including contractors, clients, and regulatory authorities, often resulting in disputes, legal conflicts, and financial penalties. By minimizing delays, construction firms can foster stronger collaboration, maintain stakeholder trust, and improve industry credibility, ultimately contributing to a more harmonious project execution environment.

COST CONTROL

Cost overruns are a direct consequence of inefficient project timelines, driven by labour inefficiencies, material shortages, and equipment downtime. By optimizing delays, project managers can maintain budgetary discipline, minimize wastage, and allocate resources effectively, ensuring financial stability while preventing unnecessary expenditure.

IMPROVED QUALITY

Projects that experience prolonged delays often lead to rushed construction phases to compensate for lost time, resulting in compromised structural integrity and subpar workmanship. Delay optimization ensures that quality standards are maintained throughout the project lifecycle, preventing defects, rework, and long-term maintenance issues.

ENVIRONMENTAL CONCERNS

Extended construction timelines contribute to increased energy consumption, excessive material usage, and elevated carbon emissions, exacerbating environmental degradation. Timely project completion supports sustainability by reducing unnecessary resource consumption and lowering the ecological footprint of construction activities. By integrating sustainable practices, the industry can contribute to global environmental conservation efforts.

TECHNOLOGICAL UTILIZATION

The construction industry is undergoing rapid digital transformation, with advanced tools such as Building Information Modelling (BIM), predictive analytics, and automation revolutionizing project management. However, the effective implementation of these technologies requires structured project timelines and minimal disruptions. Optimizing delays allows for the seamless integration of technology-driven solutions, improving efficiency, accuracy, and project predictability.

VII. LITERATURE REVIEW

Extensive academic research underscores the detrimental impact of construction delays on cost overruns and timeline deviations. Studies reveal that deficiencies in risk assessment, inefficiencies in material supply chains, and workforce shortages significantly contribute to project stagnation. Furthermore, research indicates that leveraging advanced project management methodologies and real-time tracking mechanisms can play a pivotal role in minimizing uncertainties and optimizing workflow efficiency.

VIII. DATA COLLECTION

The research adopted a structured approach to data collection, combining quantitative and qualitative methods to ensure a comprehensive understanding of construction delays. A well-designed questionnaire survey was employed to gather insights from diverse construction professionals, including contractors, project managers, site engineers, architects, and regulatory officials. The survey utilized a Likert scale (ranging from 1 to 5) to quantify perceptions regarding the causes, impacts, and mitigation strategies for construction delays. The questionnaire covered various aspects, such as demographic information, industry experience, primary delay factors, consequences of delays, and potential mitigation techniques. A stratified random sampling method was implemented to ensure balanced representation from different sectors of the construction industry. A total of **101** responses were collected, ensuring statistical validity for the study.

Additionally, site visits and industrial interactions were conducted across various project types, including residential, commercial, and infrastructure developments. These visits provided real-time observations of common delay factors such as material shortages, labour inefficiencies, inadequate project coordination, adverse weather conditions, and equipment failures. Firsthand interactions with industry professionals enabled the collection of qualitative insights, further validating the survey findings. Experts emphasized the significance of proactive planning, stakeholder collaboration, and technology adoption in mitigating delays. The integration of site visit observations and expert opinions into the research ensured a well-rounded analysis, bridging the gap between theoretical knowledge and real-world industry challenges. The collected data was systematically analysed using SPSS software to identify patterns, correlations, and critical factors contributing to project delays, forming the foundation for data-driven recommendations to enhance construction efficiency.

IX. QUESTIONNAIRE OF THE RESEARCH :

1. Late payments disrupt contractor cash flow.
2. Owner's financial issues delay project schedules.
3. Design errors or incomplete studies cause delays.
4. Contractor qualifications impact project timelines.
5. Bad weather or tough terrain disrupts work.
6. Conflicts between stakeholders cause delays.
7. Poor site supervision causes delays.
8. Delays in permits or approvals slow work.
9. Material shortages or supply chain issues halt work.
10. Poor planning and scheduling cause inefficiencies.
11. Clear documentation reduce delays.
12. Efficient resource allocation prevents delays.

13. Proactive risk management helps avoid delays.
14. Early risk identification helps prevent delays.
15. Training programs improve worker and manager efficiency.
16. Experienced project managers help reduce delays.
17. Adequate funding throughout the project prevents delays.
18. Long timelines reduce construction quality.
19. Extended delays reduce public trust in construction.
20. Time overruns increase safety risks.
21. Delays cause environmental impacts like carbon emissions.
22. Delays reduce contractor and stakeholder profits.
23. Delays harm the reputation of construction companies.
24. Better communication reduce delays.
25. Better technology use reduce delays.
26. The soil conditions at the construction site significantly impact the project timeline.
27. Labor absenteeism, especially during festivals, negatively affects project schedules.
28. Shortage of skilled workers is a major cause of project delays.
29. Lack of experienced supervisors leads to inefficiencies and work delays.
30. Delayed selection of materials such as tiles and granite causes project slowdowns.
31. Loan processing delays from banks negatively impact project funding.
32. Lift clearance and installation take longer than expected, delaying the project.
33. Excavation delays, such as soil shoring requirements, cause time overruns.
34. Clients' unrealistic expectations often lead to rework and delays.
35. Cost overturns causes delays.

X. DATA ANALYSIS AND FINDINGS

MAJOR CAUSES OF DELAYS

Material procurement challenges stem from unpredictable market fluctuations and supply chain disruptions, causing significant delays in project execution. These issues often lead to resource shortages, increased costs, and extended project timelines. Labor productivity deficiencies further exacerbate delays, as skill gaps and inefficient workflow structures reduce overall efficiency and output. Additionally, frequent design revisions disrupt construction sequences, leading to misallocated resources, rework, and scheduling conflicts. External constraints such as regulatory approval delays and adverse environmental conditions further hinder progress, making it essential for project managers to implement proactive planning, risk assessment, and adaptive strategies to mitigate these disruptions effectively.

RELATIVE IMPORTANCE INDEX (RII):

The **Relative Importance Index (RII)** is a widely used statistical tool in construction management research to determine the significance level of various factors contributing to issues such as project delays, cost overruns, and risk factors. This method enables researchers to rank different factors based on their perceived importance, as assessed by survey respondents. The RII is calculated using the formula:

$$RII = \sum w / AN = (5n5+4n4+3n3+2n2+1n1)/A*N$$

where **w** represents the weight assigned to each factor based on a five-point Likert scale, **n1, n2, n3, n4, and n5** denote the number of respondents selecting each weight, **A** is the highest possible weight (which is 5 in this case), and **N** represents the total number of survey respondents. The computed RII value ranges between **0 and 1**, where values closer to **1 indicate the highest importance of a factor**, whereas values approaching **0 suggest lower significance**. This ranking methodology provides critical insights for prioritizing the most influential delay factors, helping project managers and stakeholders implement targeted mitigation strategies to enhance project efficiency.

The findings from the Relative Importance Index (RII) analysis highlight the critical factors influencing construction project delays. The top five most significant factors indicate that financial stability and effective management are paramount to project success. Cost overruns emerged as the most pressing concern **(RII: 18.78**), underscoring the financial strain caused by budget miscalculations and unexpected expenditures. Adequate funding (**RII: 18.63**) is crucial to maintaining workflow continuity, while late payments (**RII: 18.54**) directly affect project cash flow and execution. The availability of skilled workers (**RII: 18.46**) ensures operational efficiency, and competent project managers (**RII: 18.45**) play a pivotal role in coordinating and mitigating delays.

Conversely, the least significant factors, according to the RII rankings, include profitability (**RII: 15.76**), workplace conflicts (**RII: 16.23**), and construction quality concerns (**RII: 16.23**), suggesting that industry professionals prioritize financial and managerial aspects over these issues. Risk management (**RII: 16.85**) and loan processing (**RII: 16.89**) are also ranked lower, reflecting a tendency to focus more on immediate operational challenges rather than long-term strategic planning. These insights emphasize the need for improved financial planning, efficient workforce management, and proactive scheduling to mitigate project delays and enhance construction efficiency.

XI. SPSS SOFTWARE ANALYSIS

The collected survey responses were systematically analysed using SPSS (Statistical Package for the Social Sciences) software to derive meaningful insights into the factors contributing to construction delays. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy yielded a value of 0.686, indicating a moderate level of adequacy for conducting factor analysis. Bartlett's Test of Sphericity was highly significant (p-value = 0.000), confirming that the dataset was appropriate for factor extraction. Principal Component Analysis (PCA) and factor loadings were utilized to group key variables associated with construction delays, while correlation and regression analysis identified the most influential factors affecting project timelines. Additionally, a classification approach using the Random Forest Genetic Algorithm (RFGA) was employed to categorize project delays into high and low-risk groups based on project characteristics. This comprehensive, data-driven methodology provided empirical validation of the research findings, enabling the prioritization of critical delay factors that require targeted intervention.

KAISER-MEYER-OLKIN (KMO) MEASURE

The **KMO Measure of Sampling Adequacy** was found to be **0.686**, which is considered **moderate**. Since a value above **0.6** is acceptable for factor analysis, the dataset qualifies for further factor extraction, though it does not reach the ideal level (>0.8).

KMO and Bartlett's Test[a]

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.686
Bartlett's Test of Sphericity	Approx. Chi-Square	1463.042
	df	595
	Sig.	.000

a. Based on correlations

KBARTLETT'S TEST OF SPHERICITY

Bartlett's Test of Sphericity was conducted to determine whether the dataset was suitable for factor analysis. The test yielded an approximate Chi-Square value of 1463.042 with 595 degrees of freedom (df) and a significance level (p-value) of 0.000. Since the p-value is less than 0.05, it confirms the presence of significant correlations among variables, thereby justifying the application of factor analysis to identify underlying patterns in construction delay factors.

ROTATED COMPONENT MATRIX INTERPRETATION

he **Rotated Component Matrix** is a crucial tool in factor analysis that helps interpret how variables group together under different factors. In this study, it was used to identify the key dimensions contributing to construction delays.

Key insights from the Rotated Component Matrix Interpretation:

- **Factor Loadings > 0.5** indicate strong associations between a variable and a particular factor, signifying that the variable contributes significantly to that factor.
- **Variables clustering under the same factor** suggest the existence of underlying dimensions or constructs, which help categorize causes of delays into meaningful groups.
- **Low factor loadings (<0.4)** indicate weak relationships, which may suggest the need for variable removal or reassignment to improve model clarity.
- **Rotation Method (e.g., Varimax)** was applied to ensure clearer differentiation between factors, making interpretation more precise by reducing overlap between components.
- This analysis helps in **identifying dominant delay factors**, aiding in strategic decision-making to mitigate project delays effectively.

Rotated Component Matrix[a]

	Raw										Rescaled									
	Component										Component									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Late payments						.431										.590				
Financial issues						.596										.758				
Errors							.298										.432			
Qualifications				.918										.876						
Bad weather	.608										.673									
Conflicts	.973										.837									
Poor supervision																				
Permits delays								.649										.797		
Material shortages	.550										.683									
Poor planning																				
Documentation					.390	.427									.408	.447				
Resource allocation										.525										.580
Risk management	.672	.455									.680	.460								
Risk identification	.652										.654									
Training programs									.792										.872	
Project managers																				
Adequate funding																				
Construction quality	.871				.525						.686				.413					
Public trust					.701										.705					
Time overrun					.905										.844					
Environmental impact		.633										.761								
Profits	.960										.822									
Reputation							.734										.865			
Communication		.559										.679								
Technology use		.283						-.280				.410						-.407		
Soil condition			.686										.767							
Labor absenteeism																				
skilled workers				.333										.507						
Selection of materials				.262										.411						
Selection of materials			.463										.576							
Loan process	.747		.415								.752		.417							
Lift			.554										.664							
Excavation of soil		.409										.533								
Expectations		.429										.613								
Cost overturns			.225										.413							

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

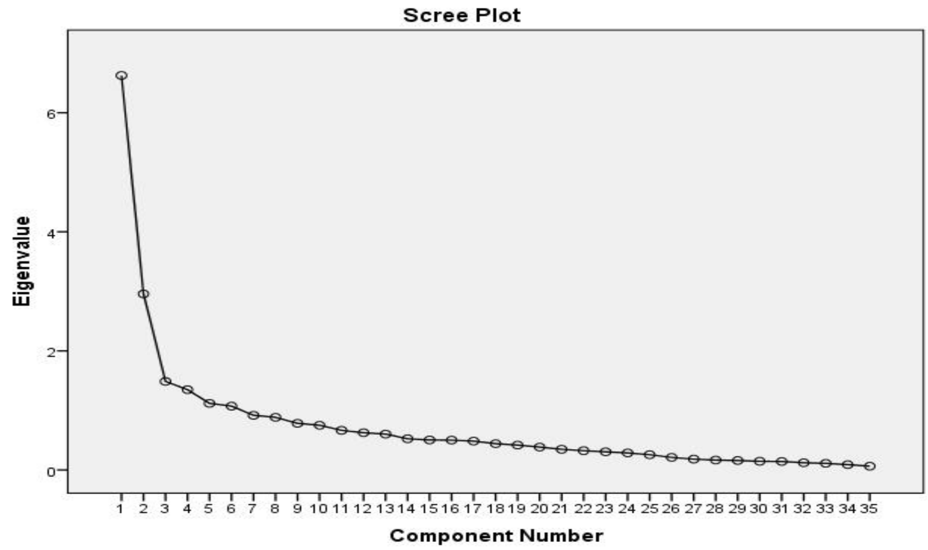
a. Rotation converged in 9 iterations.

SCREE PLOT ANALYSIS

The **Scree Plot** is a graphical tool used to determine the optimal number of factors in factor analysis. It plots the **eigenvalues** of each factor in descending order and helps identify the most significant factors to retain in the model.

Key Interpretations of the Scree Plot:

- The **"elbow point"** in the plot marks the number of factors that should be retained. This is where the slope of the curve levels off, indicating that additional factors contribute little to explaining variance.
- A **steep drop in eigenvalues** followed by a gradual decline suggests that the factors before the drop are the most meaningful and should be included in the analysis.
- If **no clear elbow point** is visible, additional validation techniques, such as **parallel analysis or cumulative variance explained**, may be used to determine the appropriate number of factors.
- Using the Scree Plot ensures that only the most relevant factors are retained, improving the accuracy of the factor analysis in identifying key causes of construction delays.



XII. CATEGORIZATION OF CONSTRUCTION DELAY FACTORS

Category	Description	Relevant Questions
Risk Factors Affecting Construction Delays	Includes regulatory, environmental, and unforeseen risks.	5, 6, 9, 13, 14, 18, 22, 31
Mitigation and Causes of Construction Delays	Focuses on preventive strategies and root causes of delays.	21, 24, 25, 33, 34
Project-Specific Challenges of Construction Delays	Addresses issues unique to individual projects, such as site conditions and project complexity.	26, 30, 32, 35
Workforce and Expertise-Related Delays in Construction	Highlights labour availability, productivity, and skill-related inefficiencies.	4, 28, 29
Consequences of Construction Delays	Evaluates financial, operational, and legal repercussions.	19, 20
Financial and Documentation Factors Affecting Construction Delays	Emphasizes budgeting, payment delays, and administrative bottlenecks.	1, 2, 11
Impact of Design and Reputation on Construction Delays	Examines the influence of design complexity and company reputation on project timelines.	3, 23

SIGNIFICANCE OF THE FINDINGS

The significance of these findings lies in their ability to **simplify complex datasets and identify meaningful patterns**, enhancing the interpretability and reliability of results. The study underscores the necessity of **proactive risk management and early problem identification**, **effective stakeholder coordination and communication**, **skilled workforce management and supervision**, **financial planning and efficient documentation practices**, and **the integration of modern technology** to optimize project timelines. By recognizing these critical areas, the research provides a **data-driven foundation** for improving project execution, reducing inefficiencies, and minimizing delays in the construction industry.

XIII. DISCUSSIONS

The project discussions highlight a wide range of factors contributing to construction delays, gathered through literature reviews, site visits, and industry consultations. Key causes include poor soil conditions, especially when dealing with loose soil or unexpected rock layers, which complicate foundation work. Pre-construction delays due to incomplete planning, design errors, and lack of timely client approvals also play a significant role. Drawing clearance issues and delays in roof construction were observed as common challenges on multiple sites.

Labor management issues, including absenteeism, lack of skilled workers, and communication barriers, disrupt project timelines. Rework caused by improper plastering level checks and the need for electrical and plumbing integrations also emerged as critical factors. Delays in lift installation and customization of lintel heights further prolonged schedules.

From an operational perspective, tangible and intangible factors such as unclear client requirements, design changes, and insufficient participation from stakeholders were prevalent. Challenges like hiring unqualified professionals, team inefficiencies, and lack of preparation time were reported across multiple sites. Joint approvals involving architects, clients, and contractors were often delayed due to miscommunication and protocol bypassing.

Financial factors like stage-by-stage payment delays, estimation disputes, and loan processing issues hindered smooth progress. Material availability was another significant concern, particularly when dealing with high-demand items like tiles and granite. Site conditions, especially proximity to sewage lines, complicated excavation and foundation work.

Weather disruptions, budget mismanagement, equipment failures, and challenges in obtaining utility connections like temporary electrical boxes were additional causes identified. Language barriers between North and South Indian labor teams led to miscommunications and subsequent rework. Vendor unavailability and the fluctuating decisions of clients also contributed to time loss.

Moreover, labor-related delays were accentuated by seasonal festivals, daily wage disputes, and inconsistent team availability. Practical issues like road restrictions for transporting oversized equipment, inadequate site conditions, and impractical design elements were commonly noted.

Ultimately, the discussions underscore the importance of proactive planning, clear communication, skilled supervision, and client awareness to mitigate delays and ensure successful project completion. Ultimately, the discussions underscore the importance of proactive planning, clear communication, skilled supervision, and client awareness to mitigate delays and ensure successful project completion.

XIV. CONCLUSION

This study employed statistical analysis to identify key factors contributing to construction delays. The dataset was confirmed to be suitable for factor analysis, as evidenced by a moderate **Kaiser-Meyer-Olkin (KMO) value (0.686)** and a **statistically significant Bartlett's test ($p < 0.05$)**. The **Total Variance Explained** analysis helped determine the optimal number of factors that capture the underlying patterns in the dataset, while the **Rotated Component Matrix and Communalities** provided valuable insights into the contribution of individual variables to each extracted factor. Variables with **low factor loadings (<0.5)** or weak communalities were identified for reconsideration, removal, or reassignment, ensuring a more accurate representation of key delay factors. Initially, the **SPSS analysis** identified **ten components**, but the final three contained only a **single variable each**, making them negligible for meaningful interpretation. By eliminating these weak components, the analysis was refined to **seven significant components** that effectively explain construction delays. The **Scree Plot Analysis** further validated the selection of relevant components by considering only factors with **eigenvalues greater than zero**, ensuring that only the most significant factors contributing to construction delays were retained. This analysis provides a **data-driven foundation** for mitigating construction delays through targeted interventions. Future studies may refine this model further by incorporating **advanced predictive analytics, stakeholder feedback, and real-time project data** to enhance decision-making and risk management strategies.

REFERENCES

1. Kevinkumar D Patel, Mamta B Rajgor, Mitigation Strategies for Overcoming Delays in High-Rise Construction Projects: A Comprehensive Literature Review, Tuijin Jishu, Journal of Propulsion Technology, ISSN: 1001-4055, Vol. 45 No. 4 (2024).
2. Anuradha Arya, Dr. Rajeev Kansal, Analysing Delays of Construction Projects in India: Causes and Effects, IJSTE - International Journal of Science Technology & Engineering, Volume 3, Issue 06, December 2016.
3. Angga T. Yudhistira, Iman Satyarn, Arief S. B. Nugroho, Tantri N. Handayani, Effect of Construction Delays and the Preventive Role of Concrete Works Optimization: Systematic Literature Review, TEM Journal. Volume 13, Issue 2, pages 1203-1217, ISSN 2217-8309, DOI: 10.18421/TEM132-34, May 2024.
4. Charan V, Sindhu Vaardini U, Ramadevi K, Prabakaran PA, A Literature Review on Impact of Delays in Construction in Terms of Time, Cost and Quality, Volume:05/Issue:09/September-2023.
5. Pramodini Sahu1, Dillip Kumar Bera, Pravat Kumar Parhi, Analyzing the Impact of Construction Delays on Disputes in India: A Statistical and Machine Learning Approach, Mech. Cont.& Math. Sci., Vol.-19, No.-9, September (2024) pp 24-34.
6. Shubham Singh, Delay Analysis in Construction Project Disputes, October 2024.
7. Hardik Saxena,yash Kumar Mittalniruti Gupta, Construction Delays in India: a Review of Shifting Focus, Mitigation, methodologies and Research Gap, the Indian Concrete Journal, February 2023.
8. Muhammad Ali Musarat, Wesam Salah Alaloul, M.S. Liew, Impact of inflation rate on construction projects budget: A review, Ain Shams Engineering Journal, October 2019.
9. Jyh-Bin Yang, Pei-Rei Wei, Causes of Delay in the Planning and Design Phases for Construction Projects, Journal of Architectural Engineering, Vol. 16, No. 2, June 1, 2010.
10. Nikitha,Shashi kumar,Dr.G.Narayana, Delay Analysis for an on-Going Multi Storied Residential Apartment Building by Scheduling with the Optimisation of Resources Using MSP.
11. Pablo González; Vicente González, Ph.D, Keith Molenaar, Ph.D., M.ASCE; and Francisco Orozco, Ph.D., Analysis of Causes of Delay and Time Performance in Construction Projects, J. Constr. Eng. Manage., 2014.
12. Alwi, Sugiharto and Hampson, Keith, Identifying the Important Causes of Delays in Building Construction Projects, 2003.
13. Søren Lindharda & Søren Wandahlb, Exploration of the reasons for delays in construction, International Journal of Construction Management, 2014.
14. Hemanta Doloi, Anil Sawhney, K.C. Iyer,
15. Sameer Rentala, analysing factors affecting delays in Indian construction projects, Project Management 30 (2012).
16. Serdar Durdyev, Causes of delays on construction projects: a comprehensive list, December 2018.
17. Sadi A. Assaf, Sadiq Al-Hejji, Causes of delay in large construction projects, International Journal of Project Management 24 (2006).
18. Mbuyamba Mbala (&), Clinton Aigbavboa, and John Aliu, Causes of Delay in Various Construction Projects: A Literature Review,2017.
19. Vishal, M. Kranti Kumar, Causes and Impact of Delay in Construction Industry of India, International Journal of Engineering Technologies and Management Research January 2021, Vol 8(1).
20. Najid SVP, Adithya Santhosh, Arobindo Gupta, Mohd Arshad Abideen Ansari, Framework for the Optimization of Construction Project, Afr. J. Biomed. Res. Vol. 27(4s) (November 2024).

21. B. U. Yılmaz, G. Can, Classification of Delay Factors in the Construction Industry According to Stakeholders and Project Types, (June 2024).
22. Ijaz Ahmad, Syed Saad, Syed Nouman Shah, Muhammad Bilal, Fabiha Fatima Agha, Sumayya Obaid, Mitigating Delay Impacts in Construction Projects: An Evaluation of Causes and Strategies, Inti Journal, Vol.2024:49.
23. Zavvar Kazim, Mohammad Sharif, Akil Ahmed, Strategies for Reducing Construction Project Delays and Cost Overruns, International Journal of Civil and Structural Engineering Research Vol. 11, Issue 1, pp: (91-98), Month: April 2023 - September 2023.
24. Mr Haridas Shivaji More, Mr. R. D. Shinde, Mr. A. B. Khemalapure, Analysis of Construction Delays in Infrastructure Projects - Causes, Impacts & Remedial Measures, International Journal of Innovative Research of Science Engineering and Technology, Volume 13, Issue 11, November 2024.
25. Anita Rauzana, Analysis of Causes of Delay and Time Performance in Construction Projects, IOSR Journal of Mechanical and Civil Engineering, Volume 13, Issue 5 Ver. III (Sep. - Oct. 2016).