Identification and Analysis of Factors of Construction Schedule Delays in Indian Construction Industry

Chinmay Shingare, Deva Dutta Dubey and Rajesh Joshi
RICSSBE, Amity University, Maharashtra, India

Keywords: Project Delays, Construction.

Abstract: Delays in project schedules can have far-reaching consequences, often leading to time and cost overruns, disputes, legal proceedings, and in some cases, project abandonment. According to Sambasivan and Soon (2007), these delays are insidious and can wreak havoc on project timelines and budgets. Clough (1986) further emphasises the detrimental effects of delays, noting that clients may suffer financial losses or hardships if projects exceed their specified completion times. Additionally, contractors bear the brunt of delay-related costs, including standby expenses for idle workers and equipment, disruptions to construction and material delivery schedules, and increased overhead expenses. The collective findings highlight the multifaceted impacts of schedule delays on both clients and contractors, underscoring the importance of proactive management strategies to mitigate their adverse effects.

1 INTRODUCTION

Delays in construction project schedules pose significant risks, impacting both cost and time overruns, as well as intangible factors such as damaging organisational reputation. To mitigate these risks, it's crucial to identify the root causes of delays through continuous analysis, monitoring, and control of project schedules.

Excusable delays, not under the regulation of the owner or contractor, and non-excusable delays, which are within their control, are both significant. Critical delays jeopardise project deadlines, while compensable delays involve compensation for the delay. Concurrent delays occur when multiple parties contribute to schedule delays.

Understanding these types of schedule delays - excusable, non-excusable, critical, compensable, and concurrent - is essential for effective project management. By recognising and addressing these delays promptly, project managers can minimise their adverse effects and ensure successful project completion within stipulated timeframes and budgets.

2 PROBLEM STATEMENT

The significant repercussions of schedule delays on construction and real estate projects, especially in Gulf countries, demand a thorough investigation to comprehend their adverse effects on project time, cost, scope, and quality. As evidenced by Aibinu and Jagboro (2002), these delays often lead to time overrun, cost overrun, disputes, arbitration, total abandonment, and litigation. Addressing this critical issue is imperative to ensure timely project completion while adhering to predefined quality standards and specifications.

3 RESEARCH OBJECTIVE

- To identify the gap in the research done on schedule delays in construction sector.
- To identify different factors which influence delays.
- To analyse the probability and severity of the schedule delay factors in the construction sector.
- To gauge relative index, to highlight various critical delay factors.
- To prepare Framework screening Ranking of Schedule Delay factors according to Highest to Lowest affecting.

Shingare, C., Dubey, D. and Joshi, R.
Identification and Analysis of Factors of Construction Schedule Delays in Indian Construction Industry.
DOI: 10.5220/0012858700003882

In *Proceedings of the 2nd Pamir Transboundary Conference for Sustainable Societies (PAMIR-2 2023)*, pages 397-403
ISBN: 978-989-758-723-8

- To identify of Top 5 Critical schedule delay factors amongst all of them as per the basis of relative index
- To identify factors which have a high correlation with the identified top five RII factors. Conclusion

4 LITERATURE REVIEW

Henry Agboola (1997) explored the causes and effects of schedule delays in Nigerian housing projects through questionnaire surveys, highlighting loss and expense claims resulting from such delays. Al-Momani (2000) investigated schedule delays on public projects in Jordan, identifying key factors such as design changes, weather, and late deliveries. Aibinu (2001) focused on Nigerian construction delays, confirming time and cost overruns as major effects. AI-Tabtabai (2002) analysed schedule delay factors in Kuwaiti projects, while Manavazhia (2002) studied cost overruns in Nepalese highway projects. Alwi (2003) ranked schedule factors in correlation with delays. Alaghbari (2007) identified delay factors in Malaysian projects, and Le-Hoai (2008) assessed Vietnamese construction delays. Agyakwah-Baah (2010) investigated project suspensions in Ghana, and Hamzaha (2011) defined delay terminologies in Malaysian projects. Kikwasi (2012) analysed interruptions in construction projects, and Aziz (2013) studied delays in Egyptian projects. Muhwezi (2014) examined delays in Ugandan construction, and Marzouk (2014) identified delays in civil construction. HOSSEN (2015) assessed delay risks in nuclear projects, and Srdić (2015) proposed models for mitigating delays. Senoucia (2016) analysed cost overruns in Qatari projects, and Arya (2016) investigated Indian delays. Alzaraa (2016) studied delays in Saudi projects, and Muhamad (2016) utilised delay analysis methodologies. Niazia (2017) identified influences on Afghan cost overruns, and Naqash (2019) examined delays in Northern Indian projects. Odeh identified factors causing cost overruns in traditional contracts, emphasising contractor perspectives. Abd El-Razek analysed schedule delays in Egyptian projects, focusing on contractors, consultants, and owners through interviews and questionnaires.

5 DATA ANALYSIS

At the top level, the 28 factors were distributed into 6 categories as under. 110 responses were received

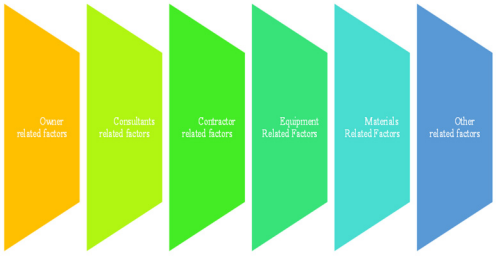

Figure 1: Broad Distribution of factors.

Table 1: indicates the constituent factors for each category of factors.

Category / Code	Factor	Category / Code	Factor
Owner	Contractor		
O1	Delay in progress payments	C1	Ineffective Project planning and scheduling
O2	Slowness in decision making process	C2	Poor Financial control of site
O3	Poor communication and coordination	C3	Rework due to errors
O4	Delay in approving Design Documents	C4	Delays in sub-contractors work
Consultant	Material		
Co1	Delay in approving major changes in scope of work	M1	Poor procurement of construction materials
Co2	Inaccurate site investigation and survey before design	M2	Shortage of construction materials
Co3	Late in reviewing and approving design documents	M3	Delay in material delivery
Co4	Delays in producing design documents	M4	Poor quality of construction materials
Equipment	Others		
E1	Equipment allocation problem	Ot1	Complexity of project (Project type, Project scale etc)
E2	Shortage of equipment	Ot2	Additional Work
E3	Slow mobilization of equipment	Ot3	Delay in obtaining permits
E4	Low efficiency/ Productivity of equipment	Ot4	Global financial crisis
E5	Low level of equipment-operator's skill	Ot5	Unfavorable weather conditions
		Ot6	Accident during construction
		Ot7	Low productivity of labor

6 RESULTS & DISCUSSIONS

Demographic profile indicators of respondents showed that 70% of the respondents had one or more years of experience in the industry. 30% of the professionals had experience of a few months to 1 year.

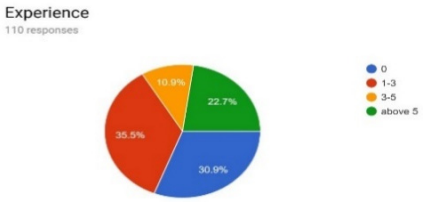

Figure 2: Experience of Respondents (in years).

Then we present scores for each factor in different categories identified for the analysis. These are presented in Figures 3 – 8.

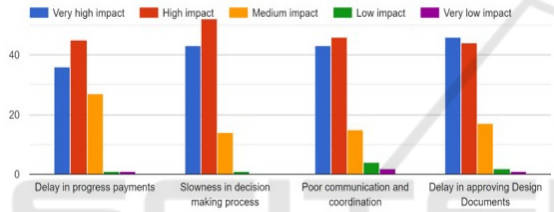

Figure 3: Responses for Owner Related Factors.

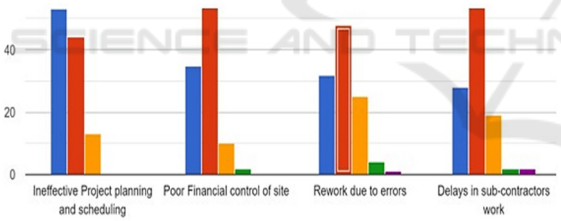

Figure 4: Responses for Contractor Related Factors.

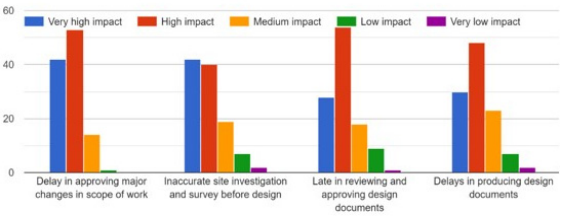

Figure 5: Responses for Consultant Related Factors.

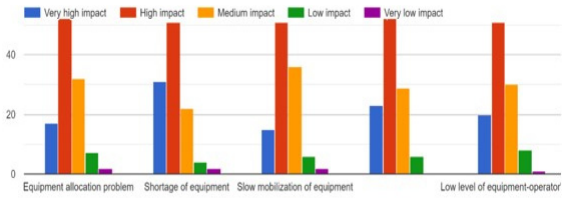

Figure 6: Responses for Equipment Related Factors.

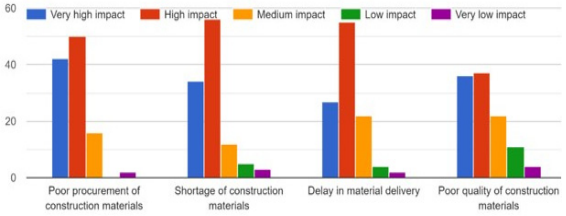

Figure 7: Responses for Materials Related Factors.

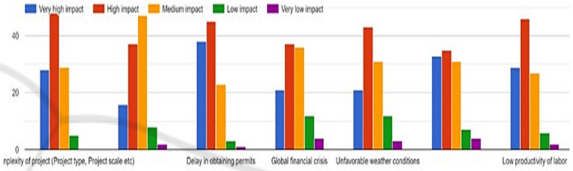

Figure 8: Responses for Other Factors.

In order understand the scores and the factors that they influence, further analysis was conducted. This would help us to find out the root cause of schedule delay which may be addressed by continuous analysis, monitor & control of the project schedule.

First and foremost, average scores of different categories of factors was studied by taking simple averages of scores across the different categories. Descriptive statistics pertaining to average scores of groups of factors is as under:

Table 1: Descriptive Statistics of Average Values of Responses to Factor.

	Min	Max	Mean	SD	Median	Mode
Count	110	110	110	110	110	110
Owner	2	5	4.15	0.51	4.25	4
Contractor	2.75	5	4.13	0.47	4	4

Consultant	2	5	4.01	0.64	4	4.25
Equipment	2	5	3.99	0.63	4	4.25
Materials	2	5	3.99	0.63	4	4.25
Others	1.57	5	3.75	0.64	3.86	4

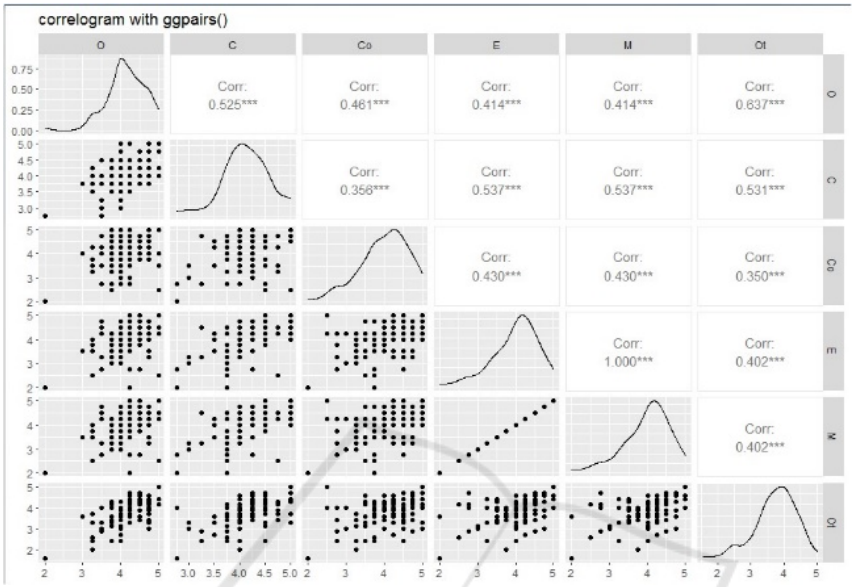

Figure 9: Plots of Pairwise Correlations of groups of factors.

Table 2: Pairwise correlation amongst different groups of factors.

	Owner	Contractor	Consultant	Equipment	Material	Others
Owner	1					
Contractor	0.52	1				
Consultant	0.46	0.36	1			
Equipment	0.41	0.54	0.43	1		
Material	0.41	0.54	0,43	1	1	
Others	0.64	0.53	0.35	0.4	0.4	1

Pairwise correlations of the average scores were obtained using R and Stata and the following table show the correlations amongst the groups of factors. Further, pairwise correlations amongst different groups of factors was examined. These are presented in Table 2.

The highest correlation is observed between Owner and Others at 0.64. The next highest one is between Contractor & Equipment and Contractor & Machinery at 0.54. This is followed by Owner and Contractor at 0.52, which is followed by correlation between Owner and Consultant at 0.46. The next highest is between Consultants & Equipment and Consultants & Materials at 0.43. This is then followed by Owner & Equipment and Owner & Materials. Owner, Contractor and Consultants are key players in the construction projects as they have a good understanding of the project from all angles.

We then identified key factors affecting the schedule delays based on Relative Importance Index using the following formulation.

$$RII = \Sigma (Wi * Xi) / \Sigma Xi \quad (1)$$

Where,

i represents category index

Wi represents weight of the ith response relating to any factor.

Xi represents frequency of the ith response given as a percentage of total responses for each factor

The RII obtained for all the factors is presented in Table 3 below.

Table 3: Computed Relative Important Index for each delay factor.

Sr. No	Delay Factors	Relative Importance index
1	Owner Related factors [Delay in progress payments]	0.8073
2	Owner Related factors [Slowness in decision making process]	0.8491
3	Owner Related factors [Poor communication and coordination]	0.8255
4	Owner Related factors [Delay in approving Design Documents]	0.84
5	Contractor Related factors [Ineffective Project planning and scheduling]	0.8727
6	Contractor Related factors [Poor Financial control of site]	0.8382
7	Contractor Related factors [Rework due to errors]	0.7927
8	Contractor Related factors [Delays in sub-contractors work]	0.7982
9	Consultant Related factors [Delay in approving major changes in scope of work]	0.8473
10	Consultant Related factors [Inaccurate site investigation and survey before design]	0.8055
11	Consultant Related factors [Late in reviewing and approving design documents]	0.78
12	Consultant Related factors [Delays in producing design documents]	0.7764
13	Equipment related factors [Equipment allocation problem]	0.7364
14	Equipment related factors [Shortage of equipment]	0.7909
15	Equipment related factors [Slow mobilization of equipment]	0.7291
16	Equipment related factors [Low efficiency/ Productivity of equipment]	0.7673
17	Equipment related factors [Low level of equipment-operator's skill]	0.7473
18	Material related factors [Poor procurement of construction materials]	0.8364
19	Material related factors [Shortage of construction materials]	0.8055
20	Material related factors [Delay in material delivery]	0.7836
21	Material related factors [Poor quality of construction materials]	0.7636
22	Other related factors [Complexity of project (Project type, Project scale etc)]	0.78
23	Other related factors [Additional Work]	0.7036
24	Other related factors [Delay in obtaining permits]	0.8109
25	Other related factors [Global financial crisis]	0.7073
26	Other related factors [Unfavorable weather conditions]	0.7218
27	Other related factors [Accident during construction]	0.7564
28	Other related factors [Low productivity of labor]	0.7709

Construction Schedule Deferrals are continuously proving to be the crucial influencing and negatively affecting factors of construction projects. These should be scrutinized on priority basis to finish the project under the specified duration and under the predefined cost. All the three aspects of construction project management are affected due to these schedule delays. Ranking of the delay factors was done and the top five results we obtained are presented in Table 4 as under.

Table 4: Top five RII Factors.

S No	Factor / Description	RII
1	C1 [Ineffective Project planning and scheduling]	0.8727
2	O2 [Slowness in decision making process]	0.8491
3	Co1 [Delay in approving major changes in scope of work]	0.8473
4	O4 [Delay in approving Design Documents]	0.84
5	C2 [Poor Financial control of site]	0.8382

These five high RII factors were further analysed on the basis of correlation amongst factors to in-turn determine component factors which demonstrated high correlation with these factors. These are presented in the following table. The table shows the factors which have high correlation with other factors.

Table 5: Constituent factors having high correlation with top five RII Factors.

Factor/Description	Correlated factor	Correlated factor	Correlated factor	Correlated factor	Correlated factor
C1 [Ineffective Project planning and scheduling]	**Ot4** [Global financial crisis] **(0.24)**	**O2** [Slowness in decision making process] **(0.19)**	**O3** [Poor communication and coordination] **(0.19)**	**C4** [Delays in sub-contractors' work] **(0.19)**	Ot2 [Additional Work] **(0.18)**
O2 [Slowness in decision making process]	**M1** [Poor procurement of construction materials] **(0.30)**	C2 [Poor Financial control of site] **(0.29)**	**Ot4** [Global financial crisis] **(0.24)**	**E3** [Slow mobilization of equipment] **(0.24)**	E1 [Equipment allocation problem] **(0.22)**
Co1 [Delay in approving major changes in scope of work]	**M1** [Poor procurement of construction materials] **(0.34)**	E2 [Shortage of equipment] **(0.24)**	**Ot1** [Complexity of project (Project type, Project scale etc.)] **(0.23)**	M4 [Poor quality of construction materials] **(0.22)**	**E3** [Slow mobilization of equipment] **(0.22)**
O4 [Delay in approving Design Documents]	**O3** [Poor communication and coordination] **(0.49)**	Ot3 [Delay in obtaining permits] **(0.46)**	Ot5 [Unfavorable weather conditions] **(0.43)**	**C4** [Delays in sub-contractors' work] **(0.41)**	Co4 [Delays in producing design documents] **(0.38)**
C2 [Poor Financial control of site]	**E3** [Slow mobilization of equipment] **(0.33)**	**Ot1** [Complexity of project (Project type, Project scale etc.)] **(0.30)**	**O2** [Slowness in decision making process] **(0.29)**	E4 Low efficiency/ Productivity of equipment] **(0.27)**	**Ot4** [Global financial crisis] **(0.28)**

**Figures in parentheses indicate correlation amongst the factors.*

- All component factors for the top five RII factors were analysed based on their frequency of occurrence.
- Constituent factors were presented alongside their descriptions, with those having high correlation with multiple top RII factors displayed in bold font.
- Notably, the high RII factors belonged to Owner, Contractor, and Consultant groups, with two factors each attributed to Owner and Contractor groups, and one to Consultant group.
- For instance, Owner Factor O4 had the highest correlation with another Owner factor, O3 (0.49), along with significant correlations with Contractors, Consultants, and other factors.
- Similarly, Consultant Factor Co1 correlated highly with materials and equipment related factors, while Contractor Factor C2 correlated significantly with Equipment, Others, and Owner factors.
- The contributory factors for the top five important factors were discussed, leading to a total of 17 overall factors considered for greater managerial attention.
- These factors could serve as recommendations for project managers to ensure project success and minimise delays.
- Managerial implications were drawn from the above findings, offering recommendations for project managers.
- Factors impacting one or more of the top five high RII factors were categorised as Exogenous Factors.
- Examples of such factors included the Global Financial Crisis, Unfavourable Weather Conditions, and Delay in Obtaining Permits.
- While beyond direct control, suitable techniques or methods could mitigate the impact of unfavourable weather conditions, requiring project managers to anticipate and prepare accordingly.
- Factors under managerial control, impacting more than one of the top five high RII factors, were identified.
- These included Project Management factors such as Complexity of project, Delay in sub-contractors work, and Slowness in decision-making process.
- Communication Skills factors like Poor Communication and Coordination also warranted attention to improve project-related information dissemination.
- Further factors impacting one of the top five high RII factors were highlighted, including Poor Financial control of site and Delays in producing design documents.
- Recommendations for addressing these factors included enhancing communication skills, improving financial control, and streamlining decision-making processes.
- By identifying key metrics and implementing suitable action plans, project managers could minimise delays and optimise project outcomes.

7 CONCLUSION

In conclusion, the comprehensive analysis of schedule delay factors in construction projects provides valuable insights for project managers aiming to enhance project success and minimise delays. By examining the frequency of occurrence and correlation of constituent factors, we identified key contributors to schedule delays, spanning across Owner, Contractor, and Consultant domains. The delineation of factors under managerial control underscores the importance of proactive management strategies in mitigating delays. Furthermore, the identification of exogenous factors highlights the need for strategic planning to anticipate and mitigate external challenges. The managerial implications drawn from this analysis offer actionable recommendations for project managers, encompassing areas such as project management, communication skills, and procurement practices. Implementing these recommendations can empower project managers to navigate complexities, streamline processes, and optimise project outcomes. Ultimately, this study underscores the critical role of effective management practices in achieving project success amidst dynamic project environments.

REFERENCES

Aibinu, A.A., & Jagboro, G.J. (2001). The effects of construction delays on project delivery in Nigerian construction industry.

Odeh, Abdalla M., & Battaineh, H.T. (n.d.). Causes of construction delays- Traditional contracts.

Agyakwah-Baah, F. D. (2010, July). Delays in Building Construction Projects in Ghana.

Senoucia, Ahmed A.I. (2016). Time Delay and Cost Overrun in Qatari Public Construction Projects.

Ahmed, T. (2015, January). Delays in construction projects.

AI-Tabtabai, H. M. (2002). Causes for delays in construction projects in Kuwait. Engineering Journal of the University of Qatar.

Alavifar, Amir Hossein, & Motamedi, Shadab. (2014). Identification, Evaluation and Classification of Time Delay Risks of Construction Project in Iran. International Conference on Industrial Engineering and Operations Management, Indonesia.

Srdić, Aleksander, & Šajn, J. (2015). Delays in Construction Projects: Causes and Mitigation.

Al-Momani, A. H. (2000). Construction delay: a quantitative analysis.

Arya, Aunradha, & Kausal, Rajeev. (2016). Analysing Delays of Construction Projects in India – Causes and Effects. International Journal of Science Technology and Engineering, Vol 3, Issue 6.

Aziz, R. F. (2013). Ranking of Delay factors in construction projects after Egyptian revolution. Alexandria Engineering Journal, 52.

Sweis, G., & Sweis, R. (2008). Delays in construction projects: The case of Jordan.

Niazia, Ghulam Abbas, & Naeem, N. (2017). Significant Factors Causing Cost Overruns in the Construction Industry in Afghanistan.

Agboola, Henry, & Akinloye, Y. (1997). The causes and effects of construction delays on completion cost of housing projects in Nigeria.

Kikwasi, G. J. (2012). Causes and Effects of Delays and Disruptions in Construction Projects in Tanzania. Australasian Journal of Construction Economics and Building Conference Series.

Muhwezi, L., & Ahimbisibwe, J. (2014). An Assessment of the Factors Causing Delays on Building Construction Projects in Uganda. International Journal of Construction Engineering and Management.

Le-Hoai, Long, & Lee, Y.D. (2008). Delay and Cost Overruns in Vietnam Large Construction Projects: A Comparison with Other Selected Countries.

Abd El-Razek, M. E., & Bassioni, H.A. (n.d.). Causes of Delay in Building Construction Projects in Egypt.

Marzouk, Mohamed M., & El-Rasheed, T.I. (2014). Analyzing delay causes in Egyptian construction projects.

Manavazhia, Mohan R., & Karki, D. K. (2002). Material and equipment procurement delays in highway projects in Nepal.

Hossen, Muhammed Mufazzal, & Karim, S. K. (2015). Construction Schedule Delay Risk Assessment By Using Combined Ahp-Rii Methodology For An International Npp Project.

Hamzaha, N., & Kamaruzzaman, M. (2011). Cause of Construction Delay - Theoretical Framework.

Syed Mohammad Tahir, Naqash, & Singla, Sandeep. (2019). Significant factors affecting delays in construction projects in Northern Region of India and their relation with cost. International Journal of Scientific & Technology Research, Vol 8, Issue 11.

Muhamad, Nurul Huda, & Fathi, M. (2016). Delay Analysis Methodologies (DAMs) in Delivering Quality Projects: Contractors and Consultants' Perceptions.

Wang, Shou Qing, & Fernandez, M. F. (2004, March). Risk management framework for construction project in developing countries.

Alwi, Sugiharto, & Khalid, H. (2003). Identifying the important causes of delays in building construction projects.

Alaghbari, Wa'el, & Rizwan, M. (2007). The significant factors causing delay of building construction projects in Malaysia.