

Analysis of Contractor-Related Delay Factors in Building Construction

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doi: <https://doi.org/10.21467/proceedings.156.13>

ABSTRACT

The unforeseen circumstances which can lead to delays are one among the most significant issues in the construction business. Listing the reasons for these delays is important to minimize and improve construction quality, time, and financial management. This will facilitate the on-time completion of the project. This research concentrates entirely on contractors' influence in these delays. Contractors, engineers, project managers, and civil engineers were asked for feedback on how to prioritize the identified elements. Overall results showed that labour shortages, material shortages, contractor financial problems, subcontracting problems, inaccurate time and cost estimates by contractors were major concerns.

Keywords: Construction management, Delay time, Contractor

1 Introduction

A delay occurs when the project is not finished by the initially stated or agreed-upon contractual deadline. The contractor and project owner jointly or sometimes individually bear some of the blame. Delays are a long-standing issue that affects the building sector globally. This challenge is of great importance to practitioners, researchers, and legislators because of the magnitude of the industry and its repercussions on the economy. Construction delays are expensive. Timely project completion benefits all project participants. The clients, the contractor, the advisor, the developer, the workers, and numerous external variables can all contribute to construction project delays. Issues in communication, coordination and conflict among these groups of project participants affect the physical, social and monetary environment. Postponement of construction activities strikes the different aspects of the plan and schedule. Other associated issues including disagreements, cost overruns, time overruns, legal action, and abandonment will result from this. There are several factors that can significantly improve the quality of work by minimizing any avoidable delays and their corresponding expenses. Even though numerous studies have been conducted in different countries regarding the general delay, specialised research regarding contractor delay has not been extensively done. This study focuses on the factors associated with contractors that contribute to construction project delays.

2 Literature review

According to Jelodar *et al.* [1], the foremost contributing factors for delays include poor project planning and scheduling, ineffective site supervision, inefficient contractor interactions, problems with resource management, a lack of appropriate equipment for the job, and poor contractor coordination with technical personnel. The causes of delays were investigated by the researchers and validated using New Zealand buildings in the construction industry.

A study conducted in Nigeria Ibronke *et al.* [2] found time-out, operating costs, disputes among others, inadequate financial resources, lack of competent project managers and lack of necessary resources as the key factors. In another study, Fashina *et al.* [3] identified Contractor-related delays as the most significant



category that causes construction delays, followed by owner-related delays, consultant related delays, and material-related delays. Analyzing the severity of frequency and importance index, five most important delay factors identified by Bagaya *et al.* [4] were contractor's financial capability, owner's financial difficulties, contractor's equipment, slow payments for completed work and poor performance of subcontractor by the contractor. The most typical causes of delay, according to El-Razek *et al.* [5], were contractor financing during construction, owner's late payment to contractors, design alterations by the owner or his agent during construction, incomplete payouts during mining, and incapability to employ highly experienced construction workers.

In a study conducted by Abbasi *et al.* [6], financial difficulties of the contractor (contractor), problems in financing and providing sufficient and stable cash flow during the construction phase (owner), delays in payment to subcontractors due to poor handling of financial documents (contractor), financial problems and delays in payments for completed works (owner), problems in the payment of salaries (contractor), inflation and rise in material prices (procurement), developing an unrealistic schedule for the project (miscellaneous), unrealistic scheduling due to the shortage of professional and skilled workforce with executive experiences (contractor), preferring relationships to rules in the bidding system (owner), and defects in writing and controlling the project schedule (contractor) were identified as the prior causes of delay. Here, the majority of factors were contractor related. Gündüz *et al.* [7] defines top 15 factors among which four were contractor related and insufficient contractor expertise, inefficient construction planning as well as scheduling, subpar site management, and unsuitable contractors were among them.

Assaf *et al.* [8] studied causes of delay in large building projects in Saudi Arabia [9] and identified that the most important delay factors according to contractors were preparation and approval of shop drawings, delays in contractors' progress, payment by owners, and design changes by owners. Contractor-Related Delay Factors identified by Gunduz *et al.* [10] were unreliable subcontractors, rework due to error, poor site management and ineffective supervision. Majid *et al.* [11] identified late delivery of materials and slow mobilization as the major factor leading to contractors' poor performance along with other factors like damaged materials, poor planning, equipment breakdown and improper equipment. Marzouk *et al.* [12] studied all factors causing construction delay associated with design development, work shop drawing submission, work shop drawing approval and project parties' changes and the contractor related factors included delays caused by discrepancies in the generated design, errors or changes in the design documents provided by the employer, a lack of resources, management inexperience, a delay in receiving the information required to begin the review of the work shop drawings process, a delay in responding to employer inquiries, and changes in the construction procedure. Lo *et al.* [13] reported exceptionally low bids, inexperienced contractor, delay caused by domestic subcontractor, delay caused by nominated subcontractor, poor workmanship and occurrence of site accidents as the factors associated with contractor causing delays.

Gondia *et al.* [14] identified owner, consultants, contractor, design, labour, materials, equipment, project and external factors as the risk sources and the following factors were listed under contractor related delay factors: inadequate project planning by contractor, difficulties in financing project by contractor, incompetence or inexperience of contractor, inadequate site investigation, slow site mobilization, poor site management and supervision, delays due to unreliable subcontractors' work, frequent change of subcontractors, rework due to errors during construction, poor contractor communication with consultant and owner and conflicts between contractor and consultant and owner.

From the literature review, it is evident that the majority of research on the causes of building delays has been done in wealthy nations and are based on the researchers' experience with completed projects. Priority was also given to the identification of significant influences by the stakeholders on how they handled

each situation. However, the comparison of the perception of the factors causing delay among different categories of stakeholders has not been examined.

3 Methodology

To determine the impact and frequency of various traits on the elements that contribute to contractor-related delays in building construction, a questionnaire survey approach has been used in the study. On the basis of literature analysis and interviews with construction practitioners, a questionnaire was prepared. In order to determine the validity and reliability of the questionnaire, pilot research was carried out. The questionnaire was finalized incorporating the comments during the pilot study involving three professionals in the field with more than 20 years of experience which included a consultant, a contractor and a project manager. Contractors, project managers, engineers, and site engineers with extensive industry expertise participated in the questionnaire survey. The association between the various attributes mentioned was also ascertained by statistical analysis of the respondents' responses.

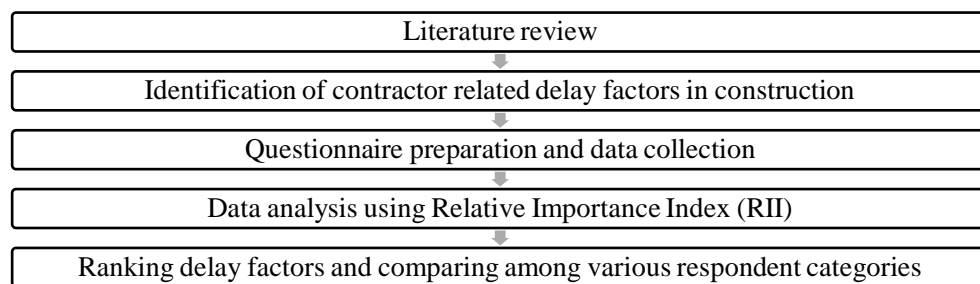


Figure 1: *Research Methodology*

The first objective is achieved using the literature review and insightful recommendations from the respondents. The second goal is crucial in order to comprehend the importance of underlying contractor-related factors influencing construction delay. The third purpose seeks to improve knowledge of the clustered effects of these attributes (factors) on project delay by figuring out the relative ranking of the traits in the hierarchy of importance. In order to achieve the third objective, it is crucial for all parties (contractor, project managers, engineers, and site engineers) to prioritise the factors according to their importance throughout construction activities and take responsibility for their respective parts in the process. The fourth goal is to determine how delays might be reduced, particularly because of these key causes.

To fulfil the study's goals, a vast amount of documented data on finished projects is required. Due to the lack of data availability for the study in Kerala, a questionnaire survey approach is chosen. The methodology used in the research is summarized in the Figure 1.

4 Identification of critical attributes affecting contractor related delay

Identification of critical attributes affecting delay is the important step as it significantly affects the reliability and efficiency of the results of the study. If insignificant attributes are selected, the outcome of the study will not be useful for improving the timely completion of construction projects. Thus, the study employs a properly prepared questionnaire to elicit major stakeholder groups' perceptions on the most probable causes of contractor-related delays. In order to incorporate the most important characteristics in the survey, an extensive literature search was conducted.

4.1 Literature Search

Many past researches have been conducted on contractor related delay, especially in developed countries, and therefore, an initial list consisting of the 68 attributes affecting construction delay was formulated from

these literatures including journals. But since these literatures are mainly from developed countries the attributes should be further analysed with respect to India.

4.2 Personal Interview

The construction professionals including contractor, project managers, engineers and site engineers were interviewed and based on this response, the list of attributes was modified. From the interviews and the study of the literature, a list of 23 attributes was obtained which includes Financial issues faced by contractor, contractor's low bid, Contractor's substandard communication level of contractor and technical employees were not coordinated well enough, inadequate project planning and scheduling, erroneous time predictions, erroneous cost projections, ineffective site control and management, Contractor's inexperience managing necessary task, a subcontracting issue, incompetent subcontractors, delays in the work of subcontractors, Changes in subcontractors, Lack of coordination and relationships between subcontractors, Unqualified work force of contractor, Rework due to construction mistakes, Shortage of manpower, Material shortages, Inadequate skill of equipment operators, Inadequate skill of equipment operators, Inappropriate construction methods (professional construction), Obsolete technology, Delays in the mobilization of workers, Conflict between contractor and consultant.

4.3 Preparation of questionnaire

Using the attributes that were collected from the literatures and interviews, the questionnaire was framed to get respondents' views on impact and frequency of each of these attributes of contractor related delay in construction building. The Questionnaire contained two sections. Section A was about General Information of the respondent such as Name, Occupation, Firm, Telephone, Email, Address, Professional background, years of practice and type of project handled. Section B contained an enquiry on the impact and frequency ratings of each attributed to contractor related delay. A five-point Likert scale was adopted to inquire the respondents of their thoughts relying on their experience in the field. The Frequency and Impact ratings used is shown in table 1.

Table 1: Frequency and Impact rating scale

	Impact ratings			Frequency ratings		
1	Very Low	-	Very slight impact on project delay	Seldom	-	Rarely occurs in a project
2	Low	-	Slight impact on project delay	Sometimes	-	Sometimes occurs in a project
3	Medium	-	Moderate impact on project delay	Often	-	Often occurs in a project
4	High	-	Significant impact on project delay	Very often	-	Very often occurs in a project
5	Very high	-	Very significant impact on delay	Always	-	Always occurs in a project

4.4 Data collection

Responses came from a diverse group of experts working on building projects (contractors, clients and engineers). A brief summary of each respondent's profile, including their professional experience and job, is included in Table 2 for those who took part in the questionnaire survey. Data from construction professionals of Kerala were collected through direct interviews, phone communication and social media platforms. Introduction conversations and contacts were undertaken with each participant and explained to make the aims of the study clear in order to elicit the best answer possible comparable to their experience

and skills. About 50 questionnaires were circulated in hard copy and electronic form, and a feedback rate of 74% resulted in the collection of 37 valid replies. The respondents include 11 contractors, 21 Project managers or Engineers and 5 site engineers.

Table 2: Respondents' profile

Category of Respondent	Experience (years)				Total responses	Percentage of responses
	< 5	5 - 10	10 - 20	> 20		
Contractor	-	1	6	4	11	30
Project manager/ Engineer	5	9	5	2	21	57
Site supervisor	4	1	-	-	5	13
Total	9	11	11	6	37	100

4.5 Other delay factors

Some other delay factors that were identified during the questionnaire survey are as follows:

- Insufficient or error in the data received by the contractor.
- Delay in government projects due to public protest
- Access to decision taking authority when there is a need for decision making
- Climatic conditions and environment
- Delay due to necessity of revision of original estimate due to the existing site condition
- Contractors' awareness about the labour union system in Kerala

The first factor has a lesser frequency of occurrence. The other factors are not relevant to the current study. So, these additional factors were not included during the analysis.

5 Descriptive analysis

A Relative Importance Index (RII) was chosen as a viable analytical technique to help this study reach its goal. The ratings from the questionnaires were analysed using this to determine a mean value, which indicates the rating for each participant category. The computation can be done using the following equation (1).

$$\text{Relative importance index; RII} = \Sigma W / (A * N) \quad (1)$$

Here, W is the score the respondent assigned to each factor, A shows the maximum weight (here 5), and N indicates the gross count of participants and the factors that cause delay for example, 5 is for very high contributing factor, 4 is for high contributing factor, 3 is for average contributing factor, 2 is for low contributing factor and 1 is for very low contributing factor [3].

5.1 Discussion

Table 3 provides an evaluation of the information gathered from the respondent categories. As per the data collected from the respondent category of contractors the most important factors were shortage of manpower, materials, financial issues, and subcontracting related problems. The effect of such factors can be controlled by proper planning and scheduling procedures. Proper scheduling and monitoring of materials and manpower can avoid any discontinuity in the construction work and thereby minimising delays and improve efficiency of the work dramatically. The second respondent category consisting of project managers and engineers comprised of 57% of the total response collected. They gave more importance to the shortage of manpower, inadequate project planning and scheduling due to errors, material shortages, lack of experience of the contractor and subcontracting problems. The category of respondents of site supervisors had given more priority to shortage of manpower, financial issues,

subcontractor who are unreliable, low bidding, lack of experience of contractor, changes in sub-contractors, materials shortages and conflicts.

Table 3: Evaluation of responses

Delay Factors	Response received from:												
	Contractor				Project manager / Engineer				Site supervisor				
	RII			Priority Ranking	RII			Priority Ranking	RII				Priority Ranking
	Impact Rating	Frequency Rating	Overall Rating		Impact Rating	Frequency Rating	Overall Rating		Impact Rating	Frequency Rating	Overall Rating		
Shortage of manpower	0.78	0.69	0.54	1	0.71	0.60	0.33	1	0.34	0.25	0.08	1	
Material shortages	0.76	0.65	0.50	2	0.66	0.55	0.34	4	0.30	0.21	0.06	7	
Financial issues faced by contractor	0.74	0.47	0.35	3	0.60	0.50	0.30	7	0.29	0.27	0.07	2	
Unqualified work force of contractor	0.50	0.41	0.21	12	0.64	0.52	0.31	18	0.32	0.20	0.06	9	
Low bidding of contractor	0.54	0.47	0.25	9	0.60	0.49	0.29	9	0.32	0.21	0.07	4	
Subcontracting problems	0.58	0.47	0.27	7	0.60	0.51	0.30	6	0.25	0.20	0.05	18	
Delays in sub-contractor's work	0.54	0.52	0.28	5	0.59	0.48	0.24	19	0.29	0.20	0.05	12	
Conflict between contractor and consultant	0.56	0.47	0.26	8	0.56	0.49	0.27	15	0.30	0.21	0.06	8	
Unreliable subcontractors	0.60	0.47	0.28	6	0.57	0.44	0.26	16	0.30	0.23	0.07	3	
Inaccurate cost estimates	0.58	0.34	0.20	16	0.59	0.50	0.29	8	0.27	0.23	0.06	10	
Inadequate skill of equipment operators	0.65	0.45	0.29	4	0.54	0.46	0.00	23	0.30	0.18	0.05	14	
Ineffective connections and cooperation between subcontractors	0.54	0.40	0.23	15	0.56	0.47	0.25	11	0.27	0.21	0.06	11	
Poor coordination of contractor with technical staff	0.58	0.36	0.21	13	0.60	0.49	0.29	10	0.25	0.20	0.05	15	
Inefficient site management and control	0.47	0.30	0.14	22	0.59	0.48	0.28	14	0.25	0.20	0.05	17	
Contractor's inexperience with a particular project	0.45	0.29	0.13	23	0.60	0.51	0.30	5	0.34	0.20	0.06	5	

Poor communication skills of contractor	0.50	0.34	0.17	19	0.58	0.49	0.28	13	0.30	0.18	0.05	13
Inaccurate time estimates	0.49	0.41	0.20	14	0.57	0.45	0.26	17	0.25	0.20	0.05	16
Changes in subcontractors	0.60	0.40	0.21	10	0.49	0.42	0.19	21	0.29	0.23	0.06	6
Obsolete technology	0.54	0.40	0.21	11	0.56	0.41	0.24	20	0.25	0.18	0.04	21
Rework resulting from construction flaws	0.45	0.43	0.19	17	0.55	0.40	0.30	3	0.25	0.14	0.03	23
Ineffective planning and Scheduling of project	0.49	0.40	0.19	18	0.71	0.46	0.33	2	0.25	0.18	0.04	19
Delays in the mobilization of workers	0.45	0.38	0.17	21	0.59	0.44	0.29	12	0.23	0.18	0.04	22
Inappropriate construction methods (professional construction)	0.50	0.34	0.17	20	0.52	0.40	0.24	22	0.25	0.18	0.04	20

5.2 Response comparison

The responses among the respondent categories were compared as shown in Table 4. It can be identified that there is reasonable approval between the parties in the ranking of frequency and impact of delay factors. This happens as contractors, engineers and site supervisors have the same goal, that is, completing the project while achieving the client's satisfaction. Moreover, clashing perspectives were also detected from contractors' side regarding lack of experience, inadequate skill of equipment operators and use of obsolete technology.

Table 4: Comparison of responses

Factors	Response received from:					
	Contractor		Project manager / Engineer		Site supervisor	
	RII	Ranking	RII	Ranking	RII	Ranking
Shortage of manpower	0.540	1	0.394	1	0.425	1
Material shortages	0.500	2	0.311	4	0.413	7
Financial issues faced by contractor	0.352	3	0.303	7	0.381	2
Unqualified work force of contractor	0.213	12	0.259	18	0.310	9
Low bidding of contractor	0.258	9	0.297	9	0.337	4
Subcontracting problems	0.275	7	0.308	6	0.277	18
Delays in sub-contractor's work	0.287	5	0.253	19	0.292	12
Conflict between contractor and consultant	0.267	8	0.278	15	0.312	8
Unreliable subcontractors	0.284	6	0.278	16	0.335	3
Inaccurate cost estimates	0.201	16	0.298	8	0.324	10
Inadequate skill of equipment operators	0.298	4	0.217	23	0.286	14
Ineffective connections and cooperation between subcontractors	0.204	15	0.294	11	0.307	11

Poor coordination of contractor with technical staff	0.212	13	0.297	10	0.248	15
Inefficient site management and control	0.146	22	0.287	14	0.317	17
Contractor's inexperience with a particular project	0.132	23	0.308	5	0.281	5
Poor communication skills of contractor	0.176	19	0.288	13	0.262	13
Inaccurate time estimates	0.205	14	0.261	17	0.275	16
Changes in subcontractors	0.218	10	0.236	21	0.327	6
Obsolete technology	0.218	11	0.252	20	0.295	21
Rework resulting from construction flaws	0.198	17	0.331	3	0.468	23
Ineffective planning and Scheduling of project	0.196	18	0.332	2	0.194	19
Delays in the mobilization of workers	0.174	21	0.292	12	0.220	22
Inappropriate construction methods (professional construction)	0.176	20	0.220	22	0.286	20

6 Conclusion

The research work is done to bring in light the factors that account for a substantial percentage of delays in construction industry of Kerala. The emphasis is on the factors that the contractor was able to manage during the planning and execution of the project. The most influential 23 factors were carefully selected from the 68 determinants of delay all of which were obtained through the literature research which included ineffective project planning as well as scheduling, ineffective site management and control, poor contractor communication skills and poor contractor coordination with engineering personnel, which have been stated multiple times in a significant number of the earlier works. Major challenges, which includes the contractor's financial struggles during the production phase, their adoption of unskilled labour, as well as their insufficient knowledge, were also identified as probable contributors of delays.

Top contractor delay factors identified depending on the RII ranking of data are shortage of manpower, material shortages, financial issues, subcontracting issues, inaccurate time and cost estimates from the contractors' side. All top delay factors that were identified are non-excusable. They may thus be managed by the contractor. So, contractors through proper planning and scheduling of materials, manpower, finances and subcontracts, unnecessary delays during construction works can be avoided.

7 Publisher's Note

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How to Cite

Sangeetha & Thomas (2023). Analysis of Contractor-Related Delay Factors in Building Construction. *AIJR Proceedings*, 89-97. <https://doi.org/10.21467/proceedings.156.13>

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