

Empirical Study on Causes and Effects of Delay in Residential Projects in India

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Abstract: *A construction industry has grown significantly across the world, but the delay has become a significant issue, which is observed in many civil projects. The residential projects in our country India have not escaped the tasks of failing to deliver projects on time. There are a lot of hazardous consequences due to the occurrence of delay in the construction works. The delay occurrences can be mitigated only when their causes are known. Moreover hence, the major goal of this research is to evaluate the causes and effects of delay in the residential projects of India. The summing up of 41 factors impacting the delay were compiled through a literature review and further classified into seven groups. The summing up of seven major effects was also determined through the literature survey. The distribution of the modeled questionnaire has been done to the professionals of the industry. The sum of 67 professionals took part in this review. The most preferred factors identified are 1) Unavailability of skilled workforce and labor; 2) Inappropriate planning and scheduling of contractor; 3) Poor site management and the most preferred effects of delay are a) Time overrun; b) Cost overrun; c) Decrease in profit. The relationship between factors impacting delay and effects of delay has been determined using correlation analysis in SPSS 23.*

Keywords: Factors causing delay, Effects of delay, Residential projects, Pearson's correlation analysis, SPSS 23.

1. Introduction

The construction sector is considered among the utmost important sectors in India. The Indian construction sector contributes about 8% of GDP of the nation. The industry has generated about 33 million jobs in the country. Though the construction business has grown significantly, delays and cost overrun have become a major issue in Indian residential projects. Delays are regarded as the most common issue and frequently occurring problem in many residential projects. Delays lead to disputes between the parties involved, loss of profit and may even lead to failure of a project. Thus delays are the utmost priority of professionals working in industry. Delays tend to increase the cost of a residential project along with the addition of time given.

Since the delay is an important issue, so to minimize it an identification of it is necessary. Thus the objective of the research is to determine the factors causing delays in residential projects and also the effects of delays. After both of these objectives are identified, the subsequent objective is the determination of the correlation between the causes and effects of delay in Indian residential projects.

Many residential projects in major cities of India are infamous for delays and cost overrun. Very few projects get completed on scheduled time. A survey carried out by ProEquity Real Estate Consultancy showed that approximately 7,391 projects out of 9,591 projects got delayed in cities such as Pune and Mumbai. According to new real estate act unveiled by the government of India, developers have to reimburse 11.2% interest on the delay of possession of unit to the customers. Thus now it is a very

much important and concerned issue to developers. Hence the study is to find the important factors causing delays in residential projects through a survey and to find the perception of the different parties towards the problem.

2. Literature review

In the year 2006, a researcher called Murali et al. examined the sources and consequences of delays occurring in the Malaysian construction sector. A questionnaire was designed and distributed to the clients, consultants, contractors. In this paper first objective was to determine the top ten most important factors, these ten causes are 1] Improper planning of contractor, 2] Poor site management, 3] lack of experience of contractor, 4] Inadequate payment for completed work by client, 5] Issues with sub-contractors, 6] Material shortage, 7] unavailability of labor, 8] Equipment failure, 9] Poor communication between parties, 10] Mistakes during execution. In the second objective effects of delay were evaluated, these effects are 1] Time overrun, 2] Cost overrun, 3] Disputes, 4] Arbitration, 5] Total abandonment, 6] Litigation. The author has made a significant contribution by studying the factual relationship between the sources impacting the delay and its effects. The results of this study have been very much helpful to the professionals working to reduce the occurrences of delays.

In the year 2011, the researcher called Hemanta et al. investigated the factors affecting time performance of various construction projects in India. A total of 45 attributes were identified. A questionnaire was designed and distributed to the participants; also personal interviews were taken to obtain the results. This study investigated the important factors

causing delay and developed prediction models for analyzing the impact of these causes. This study determined inefficient site management as one of the vital factors affecting the time performance of projects in India. The critical factors identified were 1] lack of commitment, 2] inefficient site management, 3] poor coordination, 4] lack of communication, 5] indistinct in project scope, 6] poor planning, 7] substandard contract. The paper concluded that regression model shows slow decision making of the client, low productivity, architects reluctance for change and rework are the reasons that affect the overall project delay. These findings are an important contribution to the industry in minimizing the delays in construction projects.

In the year 2014, the researcher called Charles et al. assessed the causes and effects of delays in housing projects in Ghana. A questionnaire was formulated to collect the data. The sampling technique was used in selecting the respondents for the study. The respondents selected were professionals working on various housing projects. This research work has recognized the crucial factors that have led to the project delays. These findings are 1] delay in payment, 2] inflation, 3] increase in material prices, 4] inadequate funds from clients, 5] variation orders, 6] poor capital market. This study also determined the critical effects, which are 1] cost overrun, 2] time overrun, 3] litigation, 4] lack of continuity by the client, 5] Arbitration. These findings will help project managers and policy makers to take measures to reduce delays in projects.

In the year 2015, the researcher called Mulenga et al. aim of this study was to assess the effects of schedule overrun in the South African construction industry. Secondary data was obtained from the literature, and a questionnaire was designed to obtain the primary data. The questionnaire was distributed to architects, civil engineers, and project managers. Data was assessed by using descriptive statistics methods. Findings obtained were 1] extension of time, 2] cost overrun, 3] loss of profit, 4] disputes, 5] poor quality of completed work, 6] stress to the client, 7] acceleration losses, 8] bad reputation, 9] delay in getting profit were the major effects of schedule overrun. This study will help the practitioners and various planning professionals.

In the year 2016, the researcher called Oussen et al. examined the frequent and significant causes of delay in public construction projects in the country Burkina Faso. The questionnaire survey was conducted by the author of the modeled questionnaire to review the causes of delay. The frequency, severity and importance index of causes was analyzed using quantitative statistical methods. The study determined the top five significant delay factors. The factors are as follows 1] financial capability of the contractor, 2] financial difficulties of the client, 3] poor sub-contractors, 4] slow payments, 5] equipment unavailability. These findings will help in planning and execution of projects and also minimize the delays occurring.

3. Research Methodology

The research methodology is a process to attain the objectives of the study. The data collection methods have

been found followed by finalization of data analysis methods and the results of analysis are presented. A questionnaire was designed to observe the views of clients, contractors, consultants on the importance of causes and effects of delay in Indian residential projects.

The questionnaire was separated into three parts. The first part of the questionnaire consist respondent's profile (i.e., name, age, work experience). The second part focuses on factors causing delays and the third part on the effects of delay. A total of 41 factors were included in second part of the questionnaire, and these 41 factors were broadly classified into seven categories. The third part of the questionnaire comprises of a sum of 7 effects. The respondents have been asked to rate these cause and effects on the five-point Likert scale.

The 41 listed factors causing delay are grouped into seven broad categories as follows:

I) Client related factors: 1] Delay in payment, 2] Changes in plan and design, 3] Slow decision making, 4] Unable to understand technical terms, 5] Extra work request.

II) Contractor related factors: 1] Poor site management of contractor, 2] Poor financial capability, 3] Improper construction methods, 4] Rework due to mistakes, 5] Inappropriate planning and scheduling of contractor, 6] Inadequate experience.

III) Consultant related factors: 1] Late preparation & approval of drawings, 2] Inexperienced consultants, 3] Delay for approval of test and inspection, 4] Reluctance to alteration, 5] Less coordination with client.

IV) Material related factors: 1] Unavailability of materials, 2] Improper storage of material, 3] Increase in price of material, 4] Delay in the procurement of materials, 5] High transportation cost of material, 6] Untrustworthy suppliers.

V) Labor and Equipment related factors: 1] Unavailability of skilled manpower and labor, 2] Equipment non-availability, 3] Poor productivity of labor and equipment, 4] Rare use of high tech equipment, 5] Equipment breakdowns, 6] Labor disputes and strikes, 7] Absenteeism of labor, 8] Scarcity of equipment spare parts.

VI) Contract related factors: 1] Legal disputes, 2] Major disputes and negotiations, 4] Improper planning of contractor during bidding stage, 5] Poor contract administration, 6] Claims.

VII) External factors: 1] Unfavorable weather condition, 2] Miscommunication between parties, 3] Accidents and injuries on site, 4] Hostile site condition, 5] Change in government policies, 6] Non-availability of utilities on site.

The seven major occurring effects due to delays are as follows:

- 1) Time overrun;
- 2) Cost overrun;

- 3) Decrease in profit;
- 4) Abandonment of project;
- 5) Poor quality of project;
- 6) Disputes;
- 7) Arbitration.

The sample size required to represent the actual population is 67. Thus the questionnaire was distributed to 85 respondents by hand, and we received 67 responses for this study. The demographic characteristic of respondents is given in Table no.1

Table 1: Demographic characteristic

Demographic Characteristic	Frequency	Percent
Age		
i) < 30	03	04.47 %
ii) 30 to 39	33	49.00 %
iii) 40 to 49	20	30.00 %
iv) 50 <	11	16.53 %
Sex		
i) Male	65	97.01 %
ii) Female	02	02.99 %
Type of respondent's organization		
i) Client	25	37.00%
ii) Consultants	19	29.00%
iii) Contractors	23	34.00%
Work experience in years		
i) 5 to 9	16	23.88%
ii) 10 to 19	32	47.77%
iii) above 20	19	28.35%

RII (Relative Importance Index): in the year 2008 by the researcher called Kometa et al. used this method to determine the important factors causing delay and effects of delay. This same method is used to attain the first objective, i.e., to obtain the top ten important factors causing delays. The ratings obtained from the respondents on the 5 point scale is transferred to RII for each factor using the given below formula.

$$RII = \frac{\sum W}{A \times N}$$

W=Weightage given to factor

A = highest weight i.e 5 in this case

N = total no.of respondents

Using above method, factors are ranked, and the most important factors are evaluated. The above same method is adopted to rank the effects. These rankings are used to cross compare the relative importance of the causes and effects as perceived by all the three categories of respondents.

The spearman's rank correlation has been used to check the agreement between the groups of respondents.

Correlation Analysis: The main goal of this research work is to scrutinize the association between the causes and effects. Correlation analysis is done by using Pearson's correlation coefficient in SPSS 23, and the correlation matrix has been presented.

4. Data Analysis

In this section, results of the study have been presented.

4.1 Causes of delay: Data has been analyzed from the viewpoint of the contractor, client, and consultant. This data has been collected from the second part of the questionnaire. The RII is computed for each factor causing a delay in Indian residential projects.

The causes have been grouped into seven broad categories, and these categories are ranked according to client, contractor and consultant's perspective and have been formulated below in Table 2.

Table 2: Ranking of categories of causes

Categories	Client		Consultant		Contractor		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Client related	0.606	6	0.601	5	0.670	4	0.625	5
Contractor related	0.702	1	0.700	1	0.693	2	0.698	1
Consultant related	0.686	2	0.624	3	0.701	1	0.671	2
Material related	0.680	3	0.620	4	0.668	5	0.656	4
Labor & Equipment	0.670	4	0.660	2	0.680	3	0.670	3
Contract related	0.646	5	0.530	6	0.565	6	0.580	6
External related	0.586	7	0.524	7	0.530	7	0.546	7

The above results obtained show that contractor related factors are the most contributing to delay and the externally related factors are the least contributing factors in Indian

residential projects. So, as to test the agreement between the parties as to the categories of factors causing delay, the spearman's rank correlation is computed below in Table 3.

Table 3: Spearman rank correlation for categories

Ranking		Client	Consultant	Contractor
Client	Correlation Coefficient	1.00	0.857*	0.786*
	Sig.(2-tailed)	.	0.014	0.036
	N (number of categories)	7	7	7
Consultant	Correlation Coefficient	0.857*	1.000	0.857*
	Sig.(2-tailed)	0.014	.	0.014
	N (number of categories)	7	7	7
Contractor	Correlation Coefficient	0.786*	0.857*	1.000
	Sig.(2-tailed)	0.036	0.014	.
	N (number of categories)	7	7	7

The above table gives that degree of agreement between the parties is significant at 0.05 level. Moreover, the results are satisfactory. Thus we can state that there is a high degree of agreement between the parties.

Hence, further, the RII of all factors causing delays is computed based on the ratings given by all respondents on the Likert scale. Using the RII, the factors have been ranked, and the top causes of delays in residential projects are identified. The top factors causing delays are as shown below in Table 4.

Table 4: Ranking of top causes of delay

Sr.no	Factors Causing Delays	RII	Rank
23	Unavailability of skilled manpower and labor	0.859	1
06	Inappropriate planning and scheduling of contractor	0.856	2
11	Poor site management of contractor	0.847	3
02	Delay in payment by client	0.808	4
16	Inexperienced consultants	0.782	5
31	Legal disputes	0.746	6
17	Unavailability of materials	0.743	7
12	Late preparation and approval of drawings by consultant	0.737	8
20	Delay in procurement of materials	0.728	9
07	Poor financial capability of contractor	0.716	10

Thus we can conclude that the most preferred factors causing delay are 1) Unavailability of skilled workforce and labor, 2) Inappropriate planning and scheduling of contractor and 3) Poor site management of contractor.

the client, contractor, and consultant. The RII has been computed for each effect of delay in residential projects.

The seven vital effects of delay have been identified, and these effects are ranked according to client, contractor and consultant's view and are tabulated in Table 5.

4.2 Effects of delay: The data collected from the third part of the questionnaire has been analyzed from the viewpoint of

Table 5: Ranking of effects

Categories	Client		Consultant		Contractor		Overall	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Time overrun	0.856	1	0.915	1	0.930	1	0.900	1
Cost overrun	0.824	2	0.863	2	0.869	2	0.852	2
Decrease in profit	0.728	3	0.684	4	0.678	3	0.696	3
Poor quality of project	0.624	5	0.578	5	0.521	6	0.574	5
Abandonment of project	0.496	7	0.421	7	0.426	7	0.447	7
Disputes	0.632	4	0.694	3	0.669	4	0.665	4
Arbitration	0.544	6	0.557	6	0.565	5	0.555	6

The above results obtained show that time overrun, cost overrun, decrease in profit are the most occurring and significant effects of delay in Indian residential projects. So, as to examine the agreement between the parties as to the effects of delay, the spearman's rank correlation is computed below in Table 6.

Table 6: Spearman rank correlation for effects

Ranking		Client	Consultant	Contractor
Client	Correlation Coefficient	1.00	0.964**	0.964**
	Sig.(2-tailed)	.	0.000	0.000
Consultant	Correlation Coefficient	0.964**	1.000	0.929*
	Sig.(2-tailed)	0.000	.	0.003
Contractor	Correlation Coefficient	0.964**	0.929*	1.000
	Sig.(2-tailed)	0.000	0.003	.
	N (number of categories)	7	7	7

The above table gives that degree of agreement between the groups is significant at 0.01 level. Moreover, the results are satisfactory. Thus we can state that there is a great degree of agreement between the parties.

4.3 Correlation analysis: The key objective of this research is to evaluate the relationship between the causes of delay and effects of delay. This relationship is obtained by using Pearson's correlation coefficient in SPSS, and the correlation matrix has been tabulated in Table 7.

Table 7: Correlation Matrix

	Client Related	Contractor related	Consultant related	Material related	Labor & Equipment	Contract related	External related
Time overrun	0.039	0.245	0.024	0.013	0.026	0.059	-0.010
Cost overrun	0.096	0.280	0.075	0.049	0.093	0.056	0.145
Decrease in profit	0.369	0.184	0.342	0.136	0.440	0.276	0.366
Poor Quality	0.175	0.057	0.137	0.230	0.254	0.072	0.302
Abandonment	0.057	0.050	0.019	0.182	0.074	0.110	0.307
Disputes	0.290	0.078	0.264	0.292	0.349	0.203	0.302
Arbitration	0.294	0.078	0.260	0.290	0.342	0.200	0.304

The highlighted values in the above table are significant at 0.05 level.

5. Discussion of Results and Recommendations

In this section, the results obtained in the earlier section are discussed. First, we will discuss factors causing delay followed by effects and then the correlation between causes and effects of delay.

5.1 Causes of Delay: The above results obtained show that the factors causing delays that can be classified as most preferred causes are 1) Unavailability of skilled workforce and labor, 2) Inappropriate planning and scheduling of contractor, and 3) Poor site management of contractor.

1) Unavailability of skilled workforce and labor: The quality and quantity of workforce have a significant impact on the project. About 65% of the labors are mainly from other states and remote areas of India. The wages of these labors are low compared to locally available ones, and so the labor contractors depend more on these outside labors. These workers from outside areas frequently go back to their hometown which causes a shortage of labor in this period, and the progress of work gets slow, and thus projects get a delay.

2) Inappropriate planning and scheduling of Contractor: Contractors often do not perform any work program at the initial stage. Inappropriate planning at the beginning stage of a project exhibits throughout the project and causes delays in various further stages. The project which is well planned can only be well executed.

3) Poor site management of contractor: It is one of the most pivotal cause in impacting the delay. More often it is observed that contractors are not a technical person, thus the lack of implementation and control on site. Poor site management causes a delay in responding to the problems that occur on site, which impacts the progress of the project.

5.2 Effects of Delay: The above results obtained show that the effects of delays that can be classified as most preferred causes are 1) Time overrun, 2) Cost overrun, and 3) Decrease in profit.

1) Time overrun: Contractor related factors affect the time overrun. It has been observed that out of ten most significant factors causing delay, three causes are contractor related factors. Contractor related factors such as 1) Inappropriate planning and scheduling, 2) Poor site management, and 3) Poor financial capability are the most occurring and affecting delay in Indian residential projects and cause time overrun.

2) Cost overrun: It has been observed consistently that the schedule overrun leads to the cost overrun of the project. The above-obtained correlation matrix gives us that contractor related factors have an impact on cost overrun. Factors such as inappropriate planning and poor site management cause delay in the progress of the project, which increases the overheads and other associated costs of the activities. Moreover, it can also increase the reworks, which in return also exceed the cost of the activity and causes cost overrun.

3) The decrease in profit: From the results obtained in the earlier section, it can be concluded that client related, consultant related, labor and equipment related, contract related and externally related factors directly have an impact

on the decrease in profit in the residential projects. It has been observed that client related factors like changes in plan and design and extra work request increase the cost compared to the planned cost of the project which results in the declination of profit. Late preparation and approval of drawings by consultant cause delay in execution of the activities which in return increases the overheads and cause a decrease in profit. The factors like unavailability of skilled workforce and labor, legal disputes, accidents and injuries on site, hostile site conditions also increase the cost of the project and cause a decrease in the profit.

5.3 Correlation Analysis: Table 7 shows the correlation between the factors causing delay and effects of delay. It has been examined that almost all the causes and effects correlate linearly. Thus, we can conclude that the effects of the delay have a linear relationship with the factors causing delay. For example, increase in the occurrence of the contractor related factors, increases the time overrun.

5.4 Recommendations to reduce delays: The recommendations are divided into three parts: 1) Recommendations to clients, 2) Recommendations to contractors, and 3) Recommendations to consultants.

1) Recommendations to clients: i) Clients should not always award the work to the lowest bidder. ii) Clients should select the contractor having satisfactory work experience, high financial capability and have enough amount of skilled workforce.

2) Recommendations to contractors: i) Contractors should have a sound technical knowledge and good project management skills. ii) Contractors should have proper planning of men, material, machine and about the execution of activities before the commencement of work.

3) Recommendations to consultants: i) Consultants should not delay in preparation and approval of drawings. ii) Consultants should be well experienced and should inspect the completed work periodically.

6. Conclusion

In this research factors causing delay and effects of delay in Indian residential projects have been investigated. This research determined the most preferred factors causing a delay in Indian residential projects. The preferred factors were 1) Unavailability of skilled workforce and labor, 2) Inappropriate planning and scheduling of contractor, and 3) Poor site management of contractor.

This study also identified the most preferred effects of delay which are 1) Time overrun, 2) Cost overrun, and 3) Decrease in profit. As a significant contribution, this research also achieved a relationship between factors causing delay and effects of delay in Indian residential projects. This paper can help the professionals and also academicians to make efforts to minimize the delays in Indian residential projects.

References

- [1] M. Sambasivan and Y. W. Soon, "PROJECT," vol. 25, pp. 517–526, 2007.

- [2] H. Doloi, A. Sawhney, K. C. Iyer, and S. Rentala, "Analysing factors affecting delays in Indian construction projects," *JPMA*, vol. 30, no. 4, pp. 479–489, 2012.
- [3] Charles Teye Amoatey, Yaa Asabea Ameyaw, "Analysing delay causes and effects in Ghanaian state housing construction projects," 2015.
- [4] M. Mukuka, C. Aigbavboa, and W. Thwala, "Effects of Construction Projects Schedule Overruns: A Case of the Gauteng Province, South Africa," *Procedia Manuf.*, vol. 3, no. Ahfe, pp. 1690–1695, 2015.
- [5] O. Bagaya and J. Song, "Empirical Study of Factors Influencing Schedule Delays of Public Construction Projects in Burkina Faso," 2008.
- [6] S. Thorat, M. Khandare, "Identifying the Causes and Effects of Delay in Residential Projects," pp. 2993–2996, 2017.
- [7] A. A. Salunkhe and R. S. Patil, "Effect of Construction Delays on Project Time Overrun : Indian Scenario," *Int. J. Res. Eng. Technol.*, vol. 3, no. 1, pp. 543–547, 2014.
- [8] A. A. Salunkhe and R. S. Patil, "Statistical Methods for Construction Delay Analysis 1," vol. 9, no. 2, pp. 58–62, 2013.