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Analysing factors affecting delays in construction of institution projects

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Abstract. The socio-economic progress of each emerging nation is significantly influenced by the construction industry. The duration of the project's construction period acts as a benchmark for assessing its performance. Unwanted delays in project completion were frequently caused by unexpected issues that occurred during the conception, planning, and construction phases. Project delays have a number of negative results, including disputes and disagreement between the contractors and owner of project, high prices, a loss of productivity and revenue, and contract cancellation. Therefore, a complete study on construction project delays is important. The current study focuses on identifying and ranking the reasons why construction of institutional buildings in the state of Haryana have been delayed. The main causes of delay in institutional projects are identified by survey of people working in the construction industry. This is accomplished by conducting a critical analysis of the published literatures and distributing and collecting responses from surveys among consultants, project managers, architects, engineer and clients involved in building projects. Finally, using the relative important index, the most important factor is determined (RII). In a field survey, the delay in institutional building of Haryana is investigated. For each of the 48 reasons of delay that were discovered through research for institutional construction, the relative importance index (RII) is generated. This research reveals 'Delay in obtaining municipal permits'0is one of the most important causes of building delays overall having (RII-0.869%) of group eight that is (external factor) which was ranked the highest by all the respondents and the nationality of labours (RII-0.476%) from group four (labour related factors) was ranked the lowest. This paper provides the actionable information, recommendation and some guidelines which can be used to improve the construction process and helps to mitigate the unwanted delays.

Keywords: Construction industry, Project delay, RII, Factors analysis, Ranking

INTRODUCTION

The building industry is important for India's economic growth and development. When construction projects are completed on schedule, it shows that the construction industry is doing a good job. The construction industry in India creates a lot of jobs, second only to agriculture. However, it faces problems like not being very efficient, taking too long to finish projects, and not following professional standards [1]. Construction time is often used to measure how well a project is working and how efficiently the organization is running. When a project is completed on time, it is considered a successful project. One of the big problems in the Indian construction industry right now is the issue of delays. In 2013, more than 55% of projects were delayed. Delivery delays can happen because there aren't enough skilled workers, changes in design, fixing mistakes made during construction, prices going up, not planning properly, and other reasons. The construction sector contributes around 9.1% to the GDP of India. The Indian construction industry is made up of 200 big companies, and they provide jobs for more than 35 million people. The construction business has been expanding over the past few years, but there are some problems with it that make it one of the least structured sectors. A person who wants to buy a house would have to spend a lot of money on a housing project, and he would expect to get the home that was promised to him. But, because people didn't stay dedicated, the building work wasn't finished like they said it would be [2].

The majority of real estate building projects in Northern India struggle with the issue of time overrun, which denotes delays in construction projects. Regardless matter how straightforward or complex the project, delays are a typical occurrence in the construction industry. Any construction project must deal with the major issue of delay. In order to eliminate them or at least lessen their effects, it is crucial to recognize the major reasons behind delays

in the Indian construction industry [3]. Strategic planning of the project is required to lessen the delay effect on project productivity and performance. The benefits of pre-project planning will increase benefits, reduce risk, and provide better quality [4]. According to [5], the majority of the real estate building projects in Northern India struggle with the issue overrun in time, which denotes delays in projects of construction sector.

India's building projects and infrastructure development are viewed as a vital indicator of its progress and growth of economic. There are many problems that face many Indian construction projects from being finished on schedule. According to reports [2], it happens extremely rarely in India for a building project to be finished on time. The rentals for each equipment and machine are charged on a daily basis. Hence the project cost will also increase with the delay in days. The majority of building projects in India are delayed for various reasons. This result in a conflict between the owner and the contractor as well as time and expense overruns, as well as consumer disappointment. The impact of delays affects the cost, time, disputes and project quality. India's construction projects performed the worst in terms of keeping scheduling [6]. According to the survey, India among the other0countries has the largest average schedule overrun. (55% of the actual schedule). In the present construction aura, an impressive construction management is essential to keep the project completion on time. Every construction delay factor has its own remedial steps, so it is very important for a Project managers, Architect, Engineer and Consultant to know how to treat these factors. Some0projects are only a few days late, while others are almost a year. Therefore, in order to minimize and completely eliminate delays from any construction0project, it's essential to identify their true causes.

1. RESEARCH METHODOLOGY

For achieving the target, the information through questionnaires survey were collected from the construction sector. The questionnaire is designed to identify the current factors of institutional construction projects which cause Time overruns/Project delay. A questionnaire is used to collect information. The questionnaire is divided into two sections. The first section relates to the respondents' personal information, such as name, age, specialty, and years of experience. And the second half includes a list of the 48 reasons for delays in construction projects that have been determined. These reasons are divided into eight sections, including client, contractor, materials, labour, consultant, design, equipment, and external factors. The questionnaire is designed on the basis of primary and secondary sources in which includes old journals, literature, researches and face to face interviews. Participants are asked to rate how much they agree or disagree to each factor of group which is responsible for the project's delay according to five scale important index. A Likert scale with five points. Participants were to rank the significance and impact of a specific attribute on delay in one of their selectivity using a scale of 0 to 1 (Strongly agree=5, Agree=4, neither agree nor disagree=3, Disagree=2, strongly disagree=1).

2. THEORETICAL FRAMEWORK

Project delays are when the project takes longer to finish than the agreed-upon time. This can happen after the deadline set by both parties or after the completion date stated in the contract. Delay means that there will be more work days required to complete a job because something has happened to slow down or prolong the process. Most people think that delays are a big problem in construction projects. They happen a lot, cost a lot of money, are difficult to deal with, and can be dangerous. While it doesn't completely stop the work, delay slows it down. [7]. Delays result in reduced productivity, job interruptions, escalating costs and schedules, third-party disputes, and termination of contract or cancellation. To minimize the likelihood of a delay occurring or to spot it early, general management must monitor project progress. [8]

3. LITERATURE REVIEW

Numerous studies have been conducted to determine the reasons behind building project delays. Numerous publications have covered the many reasons why building projects are delayed. While other research examined the delay analysis techniques and the suggested measures to prevent delay, other studies highlighted the primary causes of delay in many nations for different project types.

3.1 Causes of Delay

Construction projects can be delayed for one of two reasons; internal and external causes. The Internal factors contributing to the delay include those caused by four parties**.** i.e., owner, designers, contractors, and consultants involved in the project [9]**.**

Table 1: Internal factors contributing to the delay

Contractor's responsibility:	**Consultant's responsibility:**	**Owner's responsibility**:	**External factors:**
a) The materials' site delivery being delayed. b) A lack of materials on the job site. c) Poor workmanship and building errors. d) Weak labour experience and skills. e) A lack of site workers. f) Poor labour productivity. g) Monetary issues. h) Issues with other people's coordination. i) Shortage of skilled among subcontractors. j) An absence of site contractor staff. k) Ineffective site management. l) A lack of tools and equipment on site.	a) The lack of consultants' site staff; b) A lack of knowledge on the consultant's behalf; c) Insufficient administrative and supervisory experience on the part of the consultant's site employees; d) Delayed and slow decision-making monitoring; e) Documents with mistakes; f) Taking their time to give instructions.	a) Lacking in practical expertise; b) Slowness in decision-making; c) Contractor coordination issues; d) Modifications to the contract (replacing existing work, adding new tasks to the project, and changing the requirements); e) Financial troubles (delayed payments, financial difficulties, and economic problems).	a) Market materials shortage; b) Shortage of tools and equipment c) Poor condition of weather d) Inadequate site circumstances (ground, location, etc.); e) Adversity in the economy (currency, inflation, etc.); f) Alterations to laws and rules g) Delay due to transportation h) External tasks required of public entities (roads, utilities and public services).

Any other delays that are not caused by these four parties are due to outside factors, such as the government, the suppliers of the materials, or the weather.

According to [10], delays have occurred on more than 50% of construction projects as a result of several typical issues including slow pre-planning, lateness in decision-making and delay in construction drawing approval. By comparing the main reasons of construction delays in the United Arab Emirates (UAE), the Kingdom of Saudi Arabia (KSA), and Lebanon, the research concluded that material shortages, owner delays in making decisions, and permission delays are common problems throughout the area.

The author [11] found that almost 70% of building projects were finished later than expected. They also conducted a study to look at the variables influencing project completion time, including those linked to the construction environment, participant roles and responsibilities, human factors, contract terms, planning and monitoring systems, and contract forms. They found 83 delay reasons, which they divided into eight main groups (Client-related, Project-related, design team-related, Materials, Contractor-related, Labour, Equipment, External factors) and found to be generally applicable to most projects. The "relative importance index" method, together with "rank agreement factors" and "percentage agreement factors," was utilised to analyse the survey data. [11]. These delay factors indicate certain inherent the features of project that clients, consultants, and contractors can influence.

The reasons causing delays in large construction projects of Saudi Arabia were explored in this study [3] The majority of the contractors (76%) and consultants (approximately 56%) both reported that the typical delay in time is between 10% and 30% of the original duration. A time overrun of 30% to 50% was reported by 25% of the consultants on average. Owners claimed that the primary causes of delays are labour and the contractor [3]. According to Tafazzoli, the main reasons for construction delays in the United States were changes to the original

plans, owners taking a long time to make decisions, and mistakes in the design. Relative importance index is used in the research. The study's findings can be used to effectively manage money and time in order to reduce the main reasons for delays. Building projects are plans or tasks that involve constructing or creating something, such as a house, building, or structure [12].

1. 5 DATA ANALYSIS- RELATIVE IMPORTANCE INDEX TECHNIQUE

This method is applied to determine the relative significance of delay causes and effects. In this study, all designated groups are studied using the same methodology (i.e. contractors, client, 0wner, labour, material, consultant, design, machinery and related to external factors). The researchers used the RII strategy by Lim and Alum to analyse the data from the survey questionnaire on the 48 delays. The goal of the analysis was to find out which reasons were most important for project delays. The rating for each cause was determined by adding the participants' ratings for it. The following equation could be used to determine the relative importance index (RII) (Lim and Alum)

$$RII = \left[\frac{(5N5+4N4+3N3+2N2+N1)}{5(N5+N4+N3+N2+N1)}\right]$$

Where;

N1= No. of Respondents answered (Strongly disagree)

N2= No. of Respondents answered (Disagree)

N3= No. of Respondents answered (Neither agree nor disagree)

N4= No. of Respondents answered (Agree)

N5= No. of Respondents answered (Strongly agree)

For ranking the attributes, the RII method is used which can be calculated by using the following equation. RII Relative Importance Index **= ΣW = A x N**

W -Weight given by respondent to each attribute

A - Highest weight, N -Total number of respondents

The attributes are listed from least important to most important. The factors are placed in order from most to least important in causing delays. Rank 1 has the greatest impact on delay, while the lowest rank has the smallest impact on the length of delay.

1.1 Table 2: Ranking of Delay Factors

S. No.	Factors	ΣW	RII	Ranking of all Factors	Group
1	Delay in obtaining municipal permits	226	0.8692	1	Group-8 (External factors)
2	Rain effect on construction activities	217	0.8346	2	Group-8 (External factors)
3	During construction, the agent and owner changed the design	215	0.8269	3	Group-1 (Client related factors)
4	Slowness in decision making process	211	0.8115	4	Group-1 (Client related factors)
5	Lack of high-technology mechanical equipment	211	0.8115	4	Group-7 (Machinery and equipment related factors)
6	Poor contractor site management and oversight	209	0.8038	6	Group-2 (Contractor related factors)
7	Shortage of labours	209	0.8038	6	Group-4 (Labor related factors)
8	Unclear and inadequate details in drawings	207	0.7962	8	Group-6 (Design related factors)
9	Low level of equipment-operators skill	206	0.7923	9	Group-7 (Machinery and equipment related factors)
10	Contractor's technical staff having	205	0.7885	10	Group-2 (Contractor related

	poor qualification				factors)
11	Inexperienced operators for some equipment's	205	0.7885	10	Group-4 (Labor related factors)
12	Poor labour productivity	204	0.7846	12	Group-4 (Labor related factors)
13	Late in approving and revising the design documents	202	0.7769	13	Group-6 (Design related factors)
14	Consultant delay in approving and reviewing design documents	202	0.7769	13	Group-5 (Consultant related factors)
15	Poor communication/ coordination between consultant and other parties	201	0.7731	15	Group-5 (Consultant related factors)
16	Shortage of equipment	201	0.7731	15	Group-7 (Machinery and equipment related factors)
17	Utilities in site not available (such as, water, electricity, telephone, etc.	200	0.7692	17	Group-8 (External factors)
18	Delays in producing design documents	199	0.7654	18	Group-6 (Design related factors)
19	Finishing material selection was delayed due to availability of so many materials in the market	197	0.7577	19	Group-3 (Material related factors)
20	Delays in progress payment of contractor by owner.	196	0.7538	20	Group-1 (Client related factors)
21	Contractor Poor communication and coordination with other parties.	196	0.7538	20	Group-2 (Contractor related factors)
22	Equipment breakdowns	196	0.7538	20	Group-7 (Machinery and equipment related factors)
23	Delay in consultant inspection and testing	195	0.75	23	Group-5 (Consultant related factors)
24	Delay in site mobilization	193	0.7423	24	Group-5 (Consultant related factors)
25	Insufficient data collection and survey before design	193	0.7423	24	Group-6 (Design related factors)
26	Delay in material delivery	192	0.7385	26	Group-3 (Material related factors)
27	Low productivity and efficiency of equipment	192	0.7385	26	Group-7 (Machinery and equipment related factors)
28	Poor communication and coordination	191	0.7346	28	Group-1 (Client related factors)
29	Inadequate experience of consultant	191	0.7346	28	Group-5 (Consultant related factors)
30	Hot effect of weather on construction activities	191	0.7346	28	Group-8 (External factors)
31	Conflicts between the design engineer and consultant.	190	0.7308	31	Group-5 (Consultant related factors)
32	Difficulties in financing project by contractor	188	0.7231	32	Group-2 (Contractor related factors)
33	Improper storage of material leading to damage	183	0.7038	33	Group-3 (Material related factors)

34	Complexity of project design	183	0.7038	33	Group-6 (Design related factors)
35	Accident during construction	183	0.7038	33	Group-8 (External factors)
36	Changes in government regulations and laws	182	0.7	36	Group-8 (External factors)
37	Changes in material types during construction	181	0.6962	37	Group-8 (External factors)
38	Inadequate design-team experience	181	0.6962	37	Group-6 (Design related factors)
39	Effect of social and cultural factors	180	0.6923	39	Group-8 (External factors)
40	Rework due to errors during construction.	177	0.6808	40	Group-2 (Contractor related factors)
41	Health issues of labour	176	0.6769	41	Group-4 (Labor related factors)
42	Un-use of advanced engineering design software	176	0.6769	41	Group-6 (Design related factors)
43	Labour Strike	172	0.6615	43	Group-4 (Labor related factors)
44	Defective material provided by supplier	171	0.6577	44	Group-3 (Material related factors)
45	Delay in manufacturing special building materials	171	0.6577	44	Group-3 (Material related factors)
46	Misunderstanding of owner's requirements by design engineer	165	0.6346	46	Group-6 (Design related factors)
47	Personal conflicts among labours	159	0.6115	47	Group-4 (Labor related factors)
48	Nationality of labours	124	0.4769	48	Group-4 (Labor related factors)

2. 6 SUMMARY AND CONCLUSION

The delay in Haryana's institutional construction is examined at in a field survey. In order to establish institutions, research identified 48 reasons of delay, and the relative importance index (RII) is generated for each of these factors. A survey of Architects, Engineers, Contractor, Interior designer, Project Managers, JE, Regional planner, Infrastructure planner, Sub-divisional engineer, Sr.GM, Professors and others was conducted on the causes of delay factors in institutional buildings of Haryana. The factors were evaluated and divided into eight major groups. This research reveals that one of the most critical factors of construction delay in all factors is the 'Delay in obtaining municipal permits'(RII-0.869%) of group eight that is (external factor) which was ranked the highest by all the respondents and the 'Nationality of labours'(RII-0.476%) from group four (labour related factors) was ranked the lowest.

Table 11: The most significant factor analysis result

Group-1: (Client)	During construction, the agent and owner changed the design**.** (0.826%).
Group-2: (Contractor)	Poor contractor site management and oversight (0.803%).
Group-3: (Material)	Finishing material selection was delayed due to availability of so many materials in the market (0.757%).
Group-4: (Labour)	Shortage of labours (0.803%).
Group-5: (Consultant)	Late in approving and reviewing the design document by consultant (0.776%).
Group-6: (Design)	Unclear and inadequate details in drawing (0.796%).
Group-7: (Machinery and Equipment)	Lack of advanced mechanical equipment (0.811%).
Group-8: (External)	Delay in obtaining municipal permits (0.869%)

According to the RII method of factor analysis this research identified that, Delay in obtaining permits from municipality factors are more critical to deal with because they contribute for 13.48% of a project's delay.

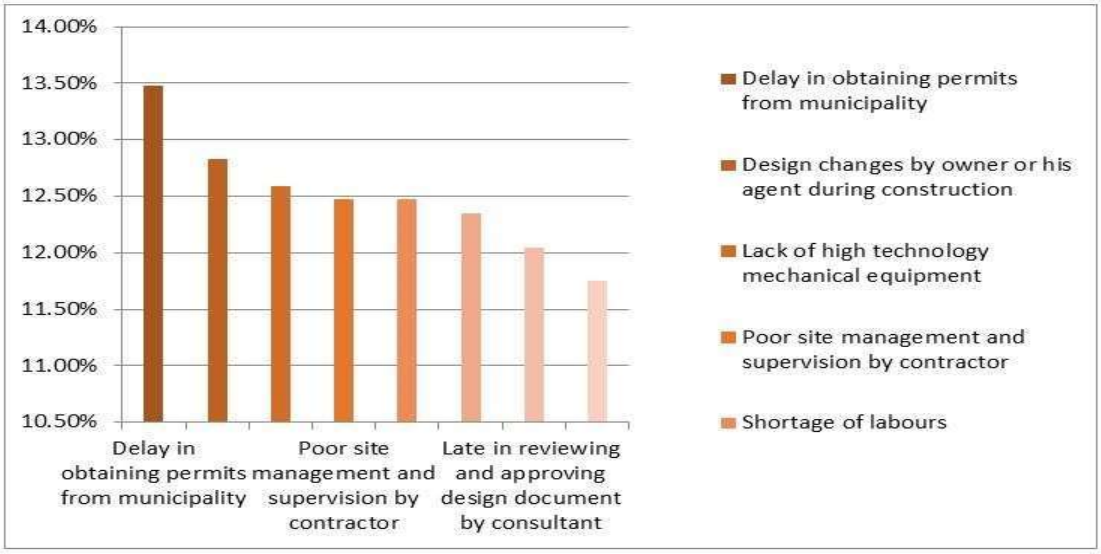

Table 12: Shows the whole group of factors which contribution of delay in institutional building.

S. No.	Factors	RII	Σw	Percentage
1	Delay in obtaining municipal permits	0.869	226	13.48%
2	During construction, the agent and owner changed the design.	0.826	215	12.83%
3	Lack of advanced mechanical equipment	0.811	211	12.59%
4	Poor contractor site management and oversight	0.803	209	12.47%
5	Shortage of labours	0.803	209	12.47%
6	Unclear and inadequate details in drawing	0.796	207	12.35%
7	Late in approving and reviewing the design document by consultant	0.776	202	12.05%
8	Finishing material selection was delayed due to availability of so many materials in the market.	0.757	197	11.75%

3. 7 RECOMMENDATION AND SUGGESTIONS

The best way to minimise client related delays is to ensure the client understands the all drawing of project. Don't make the mistake of believing 'they understand', just because it is their project. Most of the 'Design changes by owner' delay happen only when the client does not understand the drawings before the construction and later on, he understands and demands for changing. Work schedule for site masons and labour should be managed properly and coordinate the activities. The errors occur in site due to improper supervision and site management. Allocate the construction activities to the workers according to their skills. The contractor should monitor the work of workers timely. To complete the project on time, with the desired quality, and at the predicted cost, technical and administrative staff should be assigned to it.

Always order your material on time. Don't wait for old material to run out. Make sure that from which place your imported material is coming. Due to the wide variety of finishing materials available in the market, the client should seek professional advice and always choose high-quality materials from reputable brands. Enough number of workers should be hired and encouraged to increase production. Before building your labour schedule always get the details of your labour before putting them into the spread sheet like their outside lives and how much the take time to reach on site. If the consulting engineer timely checks, reviews, and approves the design submittals before the construction phase, this element of delay can be reduced. This factor of delay can be reduced if the design engineer provides the clear drawings on site. Drawing should be provided on site with proper dimension, scale and line weight. High-tech machinery equipment and technology may make construction work go more

quickly and smoothly, ensuring that projects are completed on time. Applications for permits which lack certain papers shouldn't be processed. The necessary instruction and manuals should be given to the stakeholder in the permit process. Performance of the permission process should be regularly monitored and examined time to time. Contractors must take action quickly in order to obtain permit and approvals from the relevant governmental organisations.

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