

Factors Causing Delay and Methodology of Ranking for Residential Projects

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Abstract— The construction sector in India is a significant indicator of the expansion, as it creates investment opportunities across various related sectors. Delay in construction projects is considered one of the most accepted problems causing a multitude of negative effects on the projects as well as parties engaged with it. Delay of construction project can be defined as the late completion of the work in comparison with planned schedule or contract schedule. Projects can be delayed due to number of reasons that may be due to the client, contractor, acts of God or a third party. They may occur early or later in the projects development. Delays can be minimized only when their cause are identified. The objective of this study was to identify the major causes of delays, the effects of delays, finding importance of each delay factors using Relative Importance Index and Importance Index value method. This study was carried out based on review literature and questionnaire survey. The dissertation presents the results of a questionnaire survey conducted to identify and evaluate the Relative Importance Index and Importance Index value of the significant factors contributing to delay. Respondents of this survey included personal from consultants and contractors involved in various groups. The report also suggests minimization of the identified delays.

Key words: Residential Construction Delay, Relative Importance Index (RII), Importance Index (II)

I. INTRODUCTION

Construction industry in India is growing at rapid speed. There are various projects within India currently, out of which 5% have been completed on time, the rest are either delayed or not completed on time. These delays results in considerably increase in cost of project leading to profit reduction. These projects are mainly caused by improper planning or different scenario while planning and actual execution of the project. This is because of various obstructions or uncertainties or risk involved in current activity which may not be known by planner or Engineer, this is because scenario at working site is different than as anticipated by designer or planner. A construction project is commonly acknowledged as successful, when it is completed on time, within budget, in accordance with the specifications and to stakeholder's satisfaction.

One of the most important problems in the construction projects is delays. Delays occur in every construction project and the magnitude of these delays varies considerably from project to project. Some projects are only a few days behind the schedule; some are delayed over a year. So it is essential to define the actual causes of delays in order to minimize and avoid the delays in any construction projects.

Every construction project has their own goals and objectives to be achieved such as to meet client requirement,

cost, quality needed and the finish according to the planned time. Delay in construction can be considered as one of the most recurring problem in construction industry. Construction delays in residential and light construction are often the results of miscommunication between contractors, subcontractors and property owners. Delays in construction projects are frequently expensive; since there is usually a construction loan involved which charges interest, management in wage and material prices.

II. OBJECTIVES OF WORK

- 1) To identify the factors causing delays in residential construction project.
- 2) To rank the causes of delay by Relative Importance Index (RII) and Importance Index (II) methods.
- 3) To suggest methods to minimize the identified delay factors.

III. METHODOLOGY

A. Questionnaire survey:

The questionnaire survey gives brief discussion of every statement. All the score of surveyed delays were ranked from lower value to higher value as per significance level. The questions are categorized as per significant level as 1-Not significant to 5-Extremely significant, so according to this scale higher value represent the agreement to higher or extremely significant value and lower value do not significant value. These are categorized as follows:

- 1) Not significant delay factor - 1
- 2) Slightly significant delay factor - 2
- 3) Moderately significant delay factor - 3
- 4) Very significant delays factor - 4
- 5) Extremely significant delays factor - 5

B. Relative Importance Index (RII) Method:

The relative importance index (RII) ranking method had been applied to determine the rank of the different delay causes. RII was used for the analysis because it best fits the purpose of this study from the ranking assigned to each causes of delay; it is able to identify the most difficult delays factors in the construction industries. The RII has been used in many domains to evaluate the comparative importance of a single item to others Relative Importance Index or weight is a type of relative importance analyses. RII aids in finding the contribution a particular variable makes to the prediction of a criterion variable both the itself and in combination with other predictor variables.

The equation stated below was used to compute the relative importance index for all the causes. RII for each factor is referred from journal paper of Desai Megha et al. (2013) and is given as follows:

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

Where,
W is weight age given to each factor (ranging from 1 to 5)
A is 5 (the highest weight) and
N is the total number of respondents.

C. Importance Index (II) value Method:

The other method of finding the importance of these delays factor is importance index method. The method is different for Relative Importance Index value but the results of both the methods are similar to each other. The method and formula used for both the methods are different. The value of important index is in percentage and ranges from 1 to 100 % as in case of Relative Importance Index it ranges from 0 to 1. Higher the value of Importance Index greater is the delay affected on sites.

The collected data was analyzed using importance index. In this method the total responses from the entire questionnaire are collected together and they multiplied the frequency of respondent to the different ranges of ranking and found the result. The importance index was computed from the literature papers of Abd El-Razek et al. (2008), and given by the following formula.

$$I = \sum \frac{aiXxi}{5}$$

Where,

I = Importance Index

ai = constant expressing the weight of the ith response,
xi = frequency of the ith response give as a percentage of the total responses for each causes.

1) Identification of Delay Factors:

There are many factors that contribute to causes of delay in construction projects. As per various literatures reviewed, the nine major delay factors identified in the construction sector are as given below:

- 1) Material related delay factor
- 2) Labour related delay factor
- 3) Equipment related delay factor
- 4) Design related delay factor
- 5) Consultant related delay factor
- 6) Contractor related delay factor
- 7) Owner related delay factor
- 8) Project related delay factor
- 9) External related delay factor

2) Questionnaire preparation:

A questionnaire of 55 factors is prepared for the identified nine major delays factors. This is filled by various residential construction industries by survey. The analysis is done by RII method and II value method.

IV. RESULT

RII, II values and ranking for Major Delay Factors

Sr. No	Description of Delay Factor	RII Value	% RII Value	Importance Index Value	Rank
1.	Contractor Related Delay	0.474	12.97	47.46	1
2.	Owner Related Delay	0.454	12.43	45.45	2
3.	Material Related Delay	0.439	12.02	43.93	3
4.	Design Related Delay	0.421	11.53	42.11	4
5.	Consultant Related Delay	0.407	11.14	40.72	5
6.	Labour Related Delay	0.40	10.94	40	6
7.	Equipment Related Delay	0.37	10.13	37.28	7
8.	External Related Delay	0.349	9.56	34.94	8
9.	Project Related Delay	0.339	9.28	33.39	9

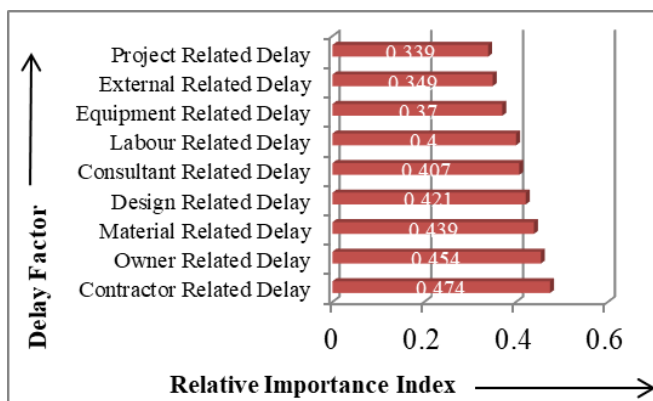


Fig. 1: RII value versus Major Related Delays

The above figure shows Relative Importance Index values for major delay factors. Therefore, Delay Contractor related delays and owner related delays were identified as the top most delay factors.

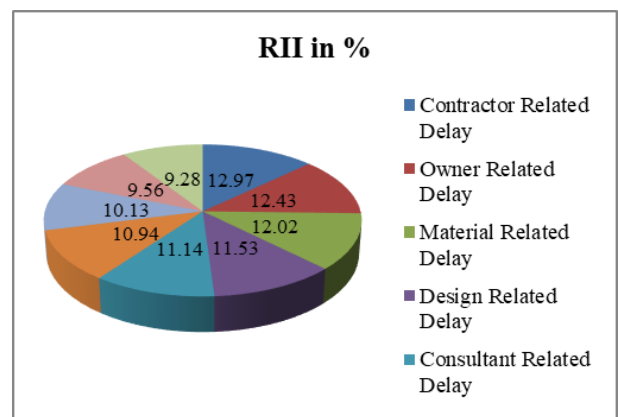
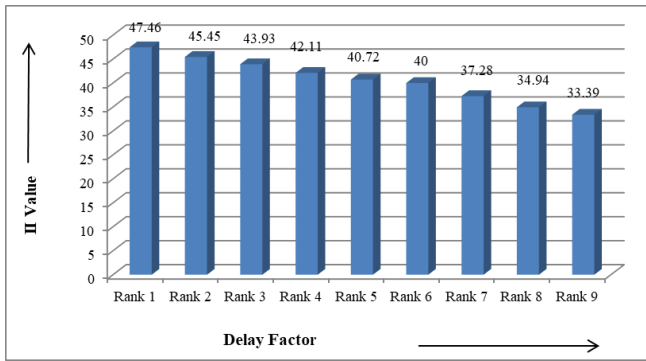


Fig. 2: RII value in Percentage of Major Delay

The above pie diagram shows Relative Importance Index value in percentage of major delays. It can be concluded that, Contractor related delays (12.97%) and Owner related delays (12.43%) are the main delay factor that causes delay in construction industry.



The above figure shows Importance Index values of major delay factors and was ranked accordingly from Importance Index method. Contractor related delay was positioned at rank 1 and Project related delay was positioned at bottom most position i.e. rank 9.

Overall RII, Importance Index Values and Ranking of each Delay Factor

Fig. 1: Importance Index value versus Major Delays

Sr. No	Delay Factor	RII Value	II Value	Rank	Delay Factor
1.	Lack of funds.	0.781	78.18	1	Owner
2.	Shortage of labour.	0.545	54.54	2	Labour
3.	Lack of man power or team to complete the project.	0.545	54.54	3	Contractor
4.	Late procurement of materials.	0.527	52.72	4	Material
5.	Shortage of material on site or market causes late delivery on site.	0.509	50.90	5	Material
6.	Absenteeism.	0.509	50.90	6	Labour
7.	Non-payment to suppliers causing stoppage to material delivery.	0.509	50.90	7	Contractor
8.	Delay in giving corrections and revisions of design and instructions.	0.491	49.09	8	Design
9.	Non-payment to sub-contractors causes less interest and slow working on project.	0.491	49.09	9	Contractor
10.	Frequent changes of sub-contractors.	0.490	49.09	10	Contractor
11.	Taking too many projects at a time causes delay.	0.490	49.09	11	Contractor
12.	Delay due to slow in decision making.	0.490	49.09	12	Owner
13.	Selecting inappropriate contractors.	0.490	49.09	13	Owner
14.	Defective design made by designer.	0.472	47.27	14	Design
15.	Poor communication and co-ordination between owners and contractors.	0.472	47.27	15	Consultant
16.	Rework due to mistakes or improper construction methods.	0.472	47.27	16	Contractor
17.	Poor quality of construction materials.	0.455	45.45	17	Material
18.	Equipment allocation problem.	0.454	45.45	18	Equipment
19.	Delay in approving drawing, design and samples.	0.454	45.45	19	Owner
20.	Escalation of material prices.	0.436	43.63	20	Material
21.	Design changes by owner, his agents or engineer during construction.	0.436	43.63	21	Design
22.	Delay due to strict checking and supervisions.	0.436	43.63	22	Consultant
23.	Poor communication and co-ordination between senior authorities.	0.436	43.63	23	Contractor
24.	Poor site planning, management, scheduling and supervision.	0.436	43.63	24	Contractor
25.	Unfavorable weather conditions.	0.436	43.63	25	External
26.	Shortage of skilled labour.	0.434	43.63	26	Labour
27.	Shortage of equipment's.	0.418	41.81	27	Equipment
28.	Lack of consultant's experience.	0.418	41.81	28	Consultant
29.	Delay in obtaining permits from authorities/municipality.	0.418	41.81	29	External
30.	Lack of experience.	0.4	40	30	Contractor
31.	Delay in performing final inspections and certification of work from clients and consultants.	0.400	40	31	External
32.	Strict supervision from senior authorities. Congested area of working or material storing.	0.400	40	32	External
33.	Lack of design team experience in construction project.	0.381	38.18	33	Design
34.	Unclear and inadequate details in drawing.	0.381	38.18	34	Design
35.	Original contract duration is too short.	0.381	38.18	35	Project
36.	Change of material type and specifications during construction.	0.363	36.36	36	Material
37.	Insufficient data collection and survey before making drawing.	0.363	36.36	37	Design
38.	Delay in performing inspection and testing.	0.363	36.36	38	Consultant

39.	Negative attitude of owner or owner's representatives causes slow responses from staff.	0.363	36.36	39	Owner
40.	Difficulties in special manufacturing materials	0.345	34.54	40	Material
41.	Conflicts between contractors and design engineers.	0.345	34.54	41	Consultant
42.	Unavailability of utilities on site.	0.345	34.54	42	External
43.	Labours strike or blockage of political parties or other organizations at local or national level.	0.327	32.72	43	Labour
44.	Legal disputes between various parties/participants.	0.327	32.72	44	Project
45.	Accidents during construction.	0.327	32.72	45	External
46.	Frequent failure or breakdown of equipment's.	0.309	30.90	46	Equipment
47.	Low level of equipment's operator skills.	0.309	30.90	47	Equipment
48.	Lack of experience in construction projects.	0.309	30.90	48	Owner
49.	Ineffective delay penalties.	0.309	30.90	49	Project
50.	Low motivation and morale of labour.	0.291	29.09	50	Labour
51.	Personal conflicts among labours.	0.291	29.09	51	Labour
52.	Poor communication and co-ordination between other parties.	0.290	29.09	52	Owner
53.	Slow site clearance.	0.290	29.09	53	External
54.	Traffic control and restriction at job site.	0.272	27.27	54	External
55.	Effects of social and cultural factors.	0.254	25.45	55	External

V. CONCLUSION & RECOMMENDATIONS

A survey of owners, contractors and consultants was conducted on the causes of delay factors in residential construction projects. The finding of factors affecting delays is conducted in order to find the importance for each factor. The result of analysis of 55 delays factor under the nine major were considered in questionnaires field by representatives.

The top major problems occurring in delays are Lack of funds which causes slow working, shortage of labour, lack of man power or team to complete the project, late procurement of materials, absenteeism, non-payment to suppliers causing stoppage to material delivery, delay in giving corrections and revisions of design and instructions, Non-payment to sub-contractors causes less interest and slow working on project.

A. General recommendations to Minimize Delays:

- Monthly meeting of sub-contractors, client should be done.
- Contractors should be aware in preparing planning, monitoring and scheduling programs. During construction, planning and scheduling may be revised if necessary conditions occur.
- Make separate material procurement department. So the delivery of construction material should not be delayed on site to work in a planned order. Early planning of material should be done from lacking of materials and also dead stock will not exhaust from the stores.
- The use of many subcontractors may lead to a high risk of delays.
- The updating of technology utilization and new construction equipment's should be used.

B. Method to Reduce Construction Delays:

Following are the various majors to control the delays which can be easily applied to construction project:

1) Sound Implementation Planning

Several software packages are available for project planning with Project Evaluation and Review Technique (PERT) /

Critical Path Method (CPM), equipment scheduling, manpower planning, cost optimization and control, monitoring etc. This could be effectively used with sound implementation planning, after proper project formulation more than half of the delayed work is covered.

2) Better Formulation and Appraisal of Projects

Investment decision on a project should be undertaken only after full investigation, collection of data, analysis and crystallization of the concept. Since in many projects, this analysis may be expensive and may require preparation of the detailed project report, the first stage clearance should be used to eliminate those project ideas which are prima-facie not viable and on which expenses for detailed analysis may not be incurred.

3) Advance Action

After the first stage examination and clearance when prima-facie viability has been established, advance action on following activities by project authorities should be permitted:

- Acquisition of land
- Getting essential clearance e.g. environment, foreign investment etc.
- Identification and type up with main technology consultant
- Preliminary design and engineering casing of tenders for main long lead plants and equipment's
- Identification and positioning of core project management team
- Arrangement for preliminary infrastructure facilities for construction.

C. Tools of Minimizing Construction delays:

1) Brainstorming

Brainstorming with a group of people is powerful management tool. Brainstorming creates new ideas, solves problems, motivates and develops teams. It motivates because it involves number of a team in bigger management issues.

2) *Project critical path analysis:*

'Critical Path Analysis' (CPA) is a very logical and effective method for planning and managing complex projects and shown as a flow diagram, whose format is linear, and specifically in time-line. A commonly used tool within Critical Path Analysis is Programme Evaluation and Review Technique (PERT) which is specialized method for identifying related and interdependent activities and events. Critical Path Analysis flow diagrams are very good for showing interdependent factors whose timings overlap or coincide.

3) *Gantt Charts*

Gantt Charts are extremely useful project management tools. Gantt Charts are excellent models for scheduling budgeting, reporting, presenting, communicating project plans and progress easily and quickly. A Gantt chart can be used to keep track of progress for each activity and costs. Gantt Charts are probably the most flexible and useful of all project management tools.

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