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CAUSES AND IMPACT OF DELAY IN CONSTRUCTION INDUSTRY OF INDIA

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ABSTRACT

Delays can be well-defined as the escalation of the stipulated time for the completion of the project. Delay is always the major loss to any construction project. In construction projects delay is a very usual thing and it can have an adverse effect on the project's time and cost. As construction is one of the largest economic activity in India, the effects of delay are still in millions, which surely decreases the GDP of the country. Delay makes the process tardy and management of delay is extremely challenging as most of the projects do not meet the expected requirement and fails to perform within time. Therefore, various types and causes of delays should be studied accurately. There are many researches on construction delays but they talk about the wide-ranging reasons of delay, so there stays a high requirement of a notable and feasible study on delays at different stages of construction process in India. The aim of the paper is to identify the causes of delays at different stages of construction through questionnaire survey in Indian construction industry. Analytical tools used in this research are relative importance index (RII) and spearman's rank correlation coefficient to rank the sources of delay with respect to its occurrence in the various stages of the construction project. The study concludes based on the correlation coefficient analysis between the construction stages, that the delays associated with before-construction stage is least related, with after-construction stage is third highly related, with construction stage is second highly related and delays associated with average/overall construction is highly related.

1. INTRODUCTION

The construction projects all over the world share a common problem which is "delay". These delays in construction can occur in various stages of the project. There are some delays that befall in the before construction phase which is precisely the initial phase of the project, which starts from the prime idea of the construction project to the official acceptance of the agreement between the owner and the contractor, but a few delays may happen during the construction stage which is the period amongst the start and end of the real construction works [1]. The basic explanation of the term "delay damages" is the cost that is increased because of delaying an event on a project. These increased costs could be direct or indirect costs [2]. Delay is defined as an event that causes extended time to

complete all or parts of a project [3]. Though some major concern is given to manage the planned schedules, a major number of projects is regarded unsuccessful when it comes to time and cost management goals. This further adds up to some adverse impact with respect to the construction project performance. It further in turn affects the stakeholders of the project such as the developer, contractor and also the owner. Hence, time and cost overruns are the main issues that is intertwined within the construction industry [4],[5]. The implications of the delay on project cost, revenue and other project outcomes in monetary terms, define the cost of delay. Certain delays can be owner caused delay that are excusable or compensable which are specified in the contract and the contractor can reclaim the time that is consequential from the delay and also the damages caused. The cost of the wasted sources such as the equipment, labor and the cost of escalation of the materials can be calculated effortlessly in these situations. Nevertheless, the contractors would also need to estimate the delays associated with the indirect costs like extended field office overhead costs or general conditions costs. Henceforth, there is a need to evolve a framework which can quantify the cost overrun plus the impact of delay which together will generate the true delay cost of the project.

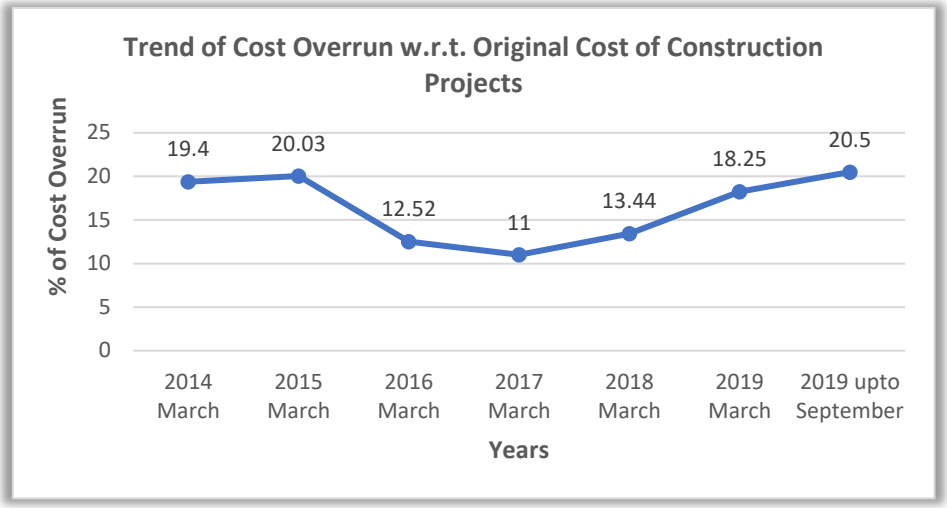

Figure 1: Trend of Cost Overrun concerning Original Cost

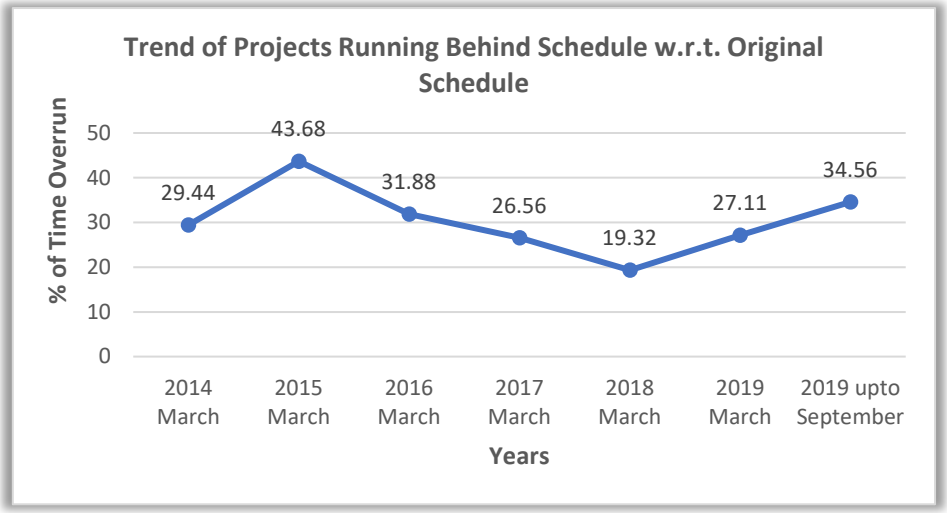

Figure 2: Trend of Projects Running Behind Schedule concerning Original Schedule

The Ministry of Statistics and Programme Implementation (MoSPI), Government of India has reported that from march-2014 to till September-2019, percentage of cost overrun of infrastructure projects concerning their original cost is increased by more than 1% that is, from 19.4% to 20.5%, see Figure 1 and percentage of time overrun of infrastructure projects concerning their original schedule is increased by 5.12% that is, from 29.44% to 34.56 %, see Figure 2 [5].

2. LITERATURE STUDY

A construction project is regarded successful when it is completes on the stipulated time, estimated budget, thereby fulfilling the specification and stakeholder satisfaction. Although, in India, 34.56 % of the infrastructure projects do not finish in the expected time in the financial year of 2019-2020. Instead, they complete after the estimated completion time, due to ambivalence in events and its unique characteristics [5]. The cost of delay is a way to understand and share the effect of time against an anticipated result. It delivers the companies with a means to comparability and calculating the cost of not completing a project or activity by opting to do it at a later time [6]. The Ministry of Statistics and Programme Implementation (MoSPI), Govt. of India has reported that in the financial year of 2019-2020 a total of 377 infrastructure projects, which worth Rs. 150 crores or more individually, which have shown the cost overruns due to delays and other reasons. The overall estimated cost of execution of the 1035 projects was Rs. 19,47,462.67 crores and the probable completion cost are expected to be Rs. 23,41,784.86 crores. The assessed total cost overruns of Rs. 3,94,361.19 crores that is, 20.25% of the original cost, see Figure 3. The ministry also reported that out of 1035 infrastructure in India monitored by it in the financial year of 2019-2020, a total of 505 projects are delayed with the time over-run ranging from 1 to 324 months [5].

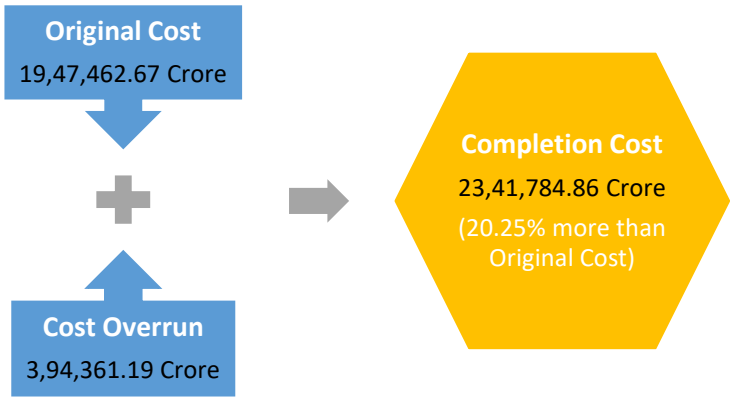

Figure 3: Cost Overrun of infrastructure projects in India in 2019 to 2020

The delays in schedule in construction projects can be majorly occurred due to the factors which are associated to project stakeholders, topography and geography of the site, change in government laws and force majeure [7],[8]. Additionally, the source of delays is associated to the uniqueness of a project. It is also defined that, the consequences of delays in cost and time in construction projects are different for different countries [9],[10].

From the inference of this literature review, this study emphasizes the objective of investigating the most critical causes of delay in the construction process and their effects in the different construction stages, which includes before-construction stage, construction stage and after-construction stage. The objectives are evaluated using relative important index (RII) and spearman's rank correlation coefficient methods. This study will be beneficial to the most construction industries in India because once a project is initiated and managed properly, it will eliminate the high cost of delay and will help in planning and execution of future construction project during executions. This study proposes to bring forward, the sources and causes of delays and disorders in construction. This research is intended to prevent the project's time and cost overrun which in turn could help the construction firms, engineers, architects, surveyors and construction project managers.

3. METHODOLOGY

The main steps of methodology adopted in this research include, (1) causes of delay selection, (2) preparing a questionnaire survey, (3) conducting purposive sampling for selection of participants for survey, (4) ranking the causes of delay using relative importance index (RII), and (5) comparing overall construction and construction stages using correlation coefficient. K.C. Iyer & Jha, 2005 identified total twenty-three critical failure attributes of projects in the context of the Indian construction industry [11]. As, the objective of this paper is to investigate the most critical causes of delay in the construction process and their effects in the different construction stages of the

Indian construction industry. So, these failure attributes are very suitable to use in this study as causes of delay, see Table 1.

The respondents will choose using purposive sampling method, which includes construction professionals from the Indian construction industry, those are, general contractors, sub-contractors, architects, project managers etc. because of their good understanding related to the objectives of this paper. Further, all the twenty-three causes were evaluated separately using a questionnaire survey, as each cause have three division as per construction stages those are, (1) Before-construction Stage, (2) Construction Stage and (3) After-construction Stage. A Likert scale of 1-5 was used to provide an effective rating for each of the cause of delay, see Table 2. Likert is an ordinal scale where the unit is unknown [12].

The motive of identifying the causes of delay is to rank them based on their chance of occurrence in construction process at before-construction stage, construction stage, after-construction stage and overall construction of the project with the help of the relative importance index (RII) method. Further identifying the most effective construction stage in project lifecycle using Spearman's Rank correlation coefficient.

Table 1: General Causes of Delay

S. No.	Causes
1	Labor strikes & poor human resource management
2	The negative attitude of project key personals
3	Holding key decisions in abeyance
4	Poor weather conditions during construction
5	Disputes between management and P.M.
6	Lack of co-ordination between of client and architect
7	Pass on the blame to others
8	Less time is given by the owner for filling tender
9	Lack of understanding of operating procedure by the P.M.
10	Conflicts among team members
11	Project completion date specified but not yet planned by the owner
12	Intangible entry at tender stage
13	Lack of timely decision by P.M.
14	The vested interest of any stakeholder to disturb project completion time
15	Hostile political & economic environment
16	Disputes between other stakeholders and P.M.
17	Rancorous social environment
18	Selection of less effective planning tools and techniques by P.M.
19	The uniqueness of the project activities requiring high technical knowledge
20	The reluctance in a timely decision by management
21	Incomplete project planning in the beginning
22	Huge size and cost of the project
23	P.M. is lacking in crisis management skills

Table 2: Likert scale

Scale Index	Level of Consideration
1	Very Low
2	Low
3	Average
4	High
5	Very High

3.1. RELATIVE IMPORTANCE INDEX (RII) METHOD

Relative Importance Index is the mean for a factor which gives it weight in the perceptions of respondents. The Relative importance index is a method that is used for evaluating the relative importance of the defined parameters (Equation 1). In this research, the RII method will be selected to find the relative importance of the varied causes of delay in construction using Likert scale, see Table 2. A cause or effect of delay is regarded as the important when the RII value is the highest and vice versa [12]. The collected data from the questionnaire survey was analyzed with the help of RII method. Each factor is further ranked according to their respective RII value.

Equation 1: $$RII = \sum \frac{W}{A \times N}$$

Here,

RII = Relative Important Index
W = Weighting given to each cause by the respondent defines in Likert Scale Index
A = Highest possible weight in responses
N = Total number of respondents

3.2. SPEARMAN'S RANK CORRELATION COEFFICIENT METHOD

To determine the relationship between ranks of two variables, spearman's rank correlation coefficient is used (Equation 2). The value of Spearman's rank (SR) correlation coefficient ranged from -1 to 1. The value of "-1 & 1" indicates perfect negative & positive correlation respectively, the values fall between "-1 to -0.5" & "0.5 to 1", indicates strong negative & positive correlation, the values fall between "-0.5 to 0" & "0 to 0.5", indicates weak negative & positive correlation, the value of 0, indicates no correlation [13]. Spearman's rank correlation coefficient is selected in this research to determine the degree of relationship between all construction stages. The best compatible construction stage will be taken from all construction stages to conclude the top ten most effective causes of delay in construction projects.

Equation 2: $$SR = \frac{6 \sum d^2}{n^3 - n}$$

Here,

SR = Spearman's Rank
d = Rank Difference
n = Number of Ranks

Table 3: RII value and rank of causes of delay at each construction stage

Aspects	Before construction		Construction		After construction		Average (Overall)	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Labor strikes & poor human resource management	0.507	13	0.733	3	0.627	3	0.622	5
The negative attitude of project key personals	0.520	12	0.720	4	0.480	14	0.573	9
Holding key decisions in abeyance	0.547	10	0.533	16	0.440	17	0.507	18
Poor weather conditions during construction	0.507	13	0.560	15	0.573	7	0.547	13
Disputes between management and P.M.	0.600	6	0.600	13	0.507	12	0.569	10

Lack of co-ordination between of client and architect	0.533	11	0.627	11	0.520	11	0.560	11
Pass on the blame to others	0.467	16	0.667	8	0.493	13	0.542	14
Less time is given by the owner for filling tender	0.440	17	0.587	14	0.453	16	0.493	19
Lack of understanding of operating procedure by the P.M.	0.627	4	0.560	15	0.467	15	0.551	12
Conflicts among team members	0.533	11	0.533	16	0.560	8	0.542	14
Project completion date specified but not yet planned by the owner	0.520	12	0.533	16	0.480	14	0.511	17
Intangible entry at tender stage	0.520	12	0.613	12	0.493	13	0.542	14
Lack of timely decision by P.M.	0.480	15	0.653	9	0.587	6	0.573	9
The vested interest of any stakeholder to disturb project completion time	0.533	11	0.613	12	0.453	16	0.533	15
Hostile political & economic environment	0.667	2	0.627	11	0.600	5	0.631	4
Disputes between other stakeholders and P.M.	0.493	14	0.587	14	0.480	14	0.520	16
Rancorous social environment	0.613	5	0.613	12	0.453	16	0.560	11
Selection of less effective planning tools and techniques by P.M.	0.560	9	0.693	6	0.520	11	0.591	8
The uniqueness of the project activities requiring high technical knowledge	0.680	1	0.747	2	0.533	10	0.653	2
The reluctance in a timely decision by management	0.573	8	0.680	7	0.667	1	0.640	3
Incomplete project planning in the beginning	0.520	12	0.640	10	0.653	2	0.604	7
Huge size and cost of the project	0.653	3	0.760	1	0.613	4	0.676	1
P.M. is lacking in crisis management skills	0.587	7	0.707	5	0.547	9	0.613	6

4. DATA ANALYSIS

The data were collected from thirty experienced respondence using questioner survey. Purposive sampling is conducted for selection of participants for this survey and selected as site engineers, project managers, contractors, architects and other professionals related to construction. The causes of delay are rated according to their RII value at different stages of construction, see Table 3. The relative importance index (RII) for all the causes is calculated by, (W1 + W2 + W3 + W4 + W5) / A x N where W = total weights given to each aspect by the respondent defines in Likert scale index, see table 2. Where '1' has the least level of consideration and '5' has the highest level of consideration. A = highest possible weight in responses (i.e., 5 in this case). N = total number of respondents (i.e., 30 in this case). The average value of relative important index (RII) obtaining in before-construction, construction, and after-construction stages is consider as the relative important index (RII) for overall construction.

5. DISCUSSIONS

5.1. RESULT ANALYSES IN EACH CONSTRUCTION STAGE

5.1.1. BEFORE-CONSTRUCTION STAGE

The top ten most cardinal causes of delay identify in before-construction stage of project according to their rank obtained after analyzing RII value. see table 3. Then, sequentially ranked as (1) "The uniqueness of the project activities requiring high technical knowledge", (2) "Hostile political & economic environment", (3) "Huge size and cost of the project", (4) "Lack of understanding of operating procedure by the P.M.", (5) "Rancorous social environment", (6) "Disputes between management and P.M.", (7) "P.M. is lacking in crisis management skills", (8) "The reluctance in a timely decision by management", (9) "Selection of less effective planning tools and techniques by P.M." and (10) "Holding key decisions in abeyance".

5.1.2. CONSTRUCTION STAGE

The top ten most cardinal causes of delay identify in construction stage of project according to their rank obtained after analyzing RII value. see table 3. Then, sequentially ranked as (1) "Huge size and cost of the project", (2) "The uniqueness of the project activities requiring high technical knowledge", (3) "Labor strikes & poor human resource management", (4) "The negative attitude of project key personals", (5) "P.M. is lacking in crisis management skills", (6) "Selection of less effective planning tools and techniques by P.M.", (7) "The reluctance in a timely decision by management", (8) "Pass on the blame to others", (9) "Lack of timely decision by P.M." and (10) "Incomplete project planning in the beginning".

5.1.3. AFTER-CONSTRUCTION STAGE

The top ten most cardinal causes of delay identify in after-construction stage of project according to their rank obtained after analyzing RII value. see table 3. Then, sequentially ranked as (1) "The reluctance in a timely decision by management", (2) "Incomplete project planning in the beginning", (3) "Labor strikes & poor human resource management", (4) "Huge size and cost of the project", (5) "Hostile political & economic environment", (6) "Lack of timely decision by P.M.", (7) "Poor weather conditions during construction", (8) "Conflicts among team members", (9) "P.M. is lacking in crisis management skills" and (10) "The uniqueness of the project activities requiring high technical knowledge".

5.1.4. OVERALL CONSTRUCTION

The average RII value obtaining by before-construction, construction and after-construction stages is consider as the relative important index (RII) value for overall construction. So, the top ten most cardinal causes of delay identify in overall construction of project according to their rank obtained after analyzing RII value. see table 3. Then, sequentially ranked as (1) "Huge size and cost of the project", (2) "The uniqueness of the project activities requiring high technical knowledge", (3) "The reluctance in a timely decision by management", (4) "Hostile political & economic environment", (5) "Labor strikes & poor human resource management", (6) "P.M. is lacking in crisis management skills", (7) "Incomplete project planning in the beginning", (8) "Selection of less effective planning tools and techniques by P.M.", (9) "The negative attitude of project key personals" and (10) "Lack of timely decision by P.M.".

Table 4: Comparison of causes of delay at different stages of construction

Most cardinal causes of delay	Rank in Before construction	Rank in Constructio n	Rank in After construction	Rank in Average (Overall)
Huge size and cost of the project	3	1	4	1

The uniqueness of the project activities requiring high technical knowledge	1	2	10	2
The reluctance in a timely decision by management	8	7	1	3
Hostile political & economic environment	2	11	5	4
Labor strikes & poor human resource management	13	3	3	5
P.M. is lacking in crisis management skills	7	5	9	6
Incomplete project planning in the beginning	12	10	2	7
Selection of less effective planning tools and techniques by P.M.	9	6	11	8
The negative attitude of project key personals	12	4	14	9
Lack of timely decision by P.M.	15	9	6	10
Disputes between management and P.M.	6	13	12	11
Rancorous social environment	5	12	16	12
Lack of understanding of operating procedure by the P.M.	4	15	15	13
Poor weather conditions during construction	13	15	7	14
Pass on the blame to others	16	8	13	15
Conflicts among team members	11	16	8	15
Holding key decisions in abeyance	10	16	17	19

5.2. GENERAL CAUSES OF DELAY IN CONSTRUCTION PROJECT

Total of seventeen causes of delay are identified as the top ten causes of delay for each construction stage (Table 4) from the total twenty-three causes of delay (Table 3), when listed down all the causes of delay of each construction stage into one column and eliminate the commons. Thus, to list general top ten causes of delay for a project, there are seven causes of delay difference found, which is 41.17% more. This analysis reviled that, causes of delay are different in different stages of construction.

The Spearman's rank correlation coefficient Method uses to find out which construction stage can be considered for finding general causes of delay to construction project. This method determine the relationship between before-construction stage, construction stage, after-construction stage and overall construction and identified the coefficient of relation between construction stages and sequentially ranked as first is overall construction with 0.47 to 0.79 correlation coefficient, second is construction stage with 0.13 to 0.79 correlation coefficient, third is after construction with -0.08 to 0.65 correlation coefficient and the last is before construction with -0.08 to 0.47 correlation coefficient (Table 5). The Spearman's rank correlation coefficient Method express, cause of delay of overall construction is most suitable to list the general causes of delay to construction projects compared to other construction stages.

Table 5: Value of Spearman's rank correlation coefficient

	Before construction	Construction	After construction	Overall
Before-construction	1.00	0.13	-0.08	0.47
Construction	0.13	1.00	0.35	0.79
After-construction	-0.08	0.35	1.00	0.65
Overall	0.47	0.79	0.65	1.00

6. CONCLUSION

The study of the survey result revealed that, in the different construction stages there is a slightly difference in the impact of delays. Most critical causes of delay are identified for three major construction project stages those are, before-construction, construction and after-construction. After that average of relative importance index (RII) value of these three constructions is taken for overall construction. The comparison of ranks of causes of delay obtaining from their RII values among before-construction stage, construction stage, after-construction stage and overall construction is performed, with the help of Spearman's rank correlation coefficient method, and as a result overall construction is highly related to other construction stages in Indian construction industry. So, the top ten most cardinal causes of delay identify in overall construction of project according to their rank obtained after analyzing RII value sequentially ranked as (1) "Huge size and cost of the project", (2) "The uniqueness of the project activities requiring high technical knowledge", (3) "The reluctance in a timely decision by management", (4) "Hostile political & economic environment", (5) "Labor strikes & poor human resource management", (6) "P.M. is lacking in crisis management skills", (7) "Incomplete project planning in the beginning", (8) "Selection of less effective planning tools and techniques by P.M.", (9) "The negative attitude of project key personals" and (10) "Lack of timely decision by P.M.".

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CONFLICT OF INTEREST

The author have declared that no competing interests exist.

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