



## **Analysis Of Critical Causes Of Delays In Indian Infrastructure Projects**

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### ***Abstract:***

*Due to the inherent risks and increasing complexity of modern construction projects, delays and cost overruns have become common facts in the industry. Researchers and practitioners have used many techniques to assess project delays and apportion delay responsibility among the parties involved. This paper deals with the causes which critically effect in delay of infrastructure projects in India. The delays and cost overruns have become a hallmark of infrastructure projects in India. Recently commissioned, Bandra-worli sea link amply demonstrates the state of project delivery system in the country. It was planned as a Rs300 crore project to be completed by 2004, has actually cost Rs1600 crores with the delay of five years. A survey with different construction companies in India is done to find out the critical reasons which are mainly affecting in the delay of the construction projects in India.*

*With the help of the literature reviews and a discussion with various construction parties 73 causes of delay are found which are mainly affecting the industry. The identified causes are combined into nine groups. The field of survey included 20 contractors, 1 consultant, and 1 owner. Data collected were analyzed by frequency, severity and importance indices. The members of survey were from the various construction industries of India. The names were listed in the paper.*

## **1.Introduction**

The focus of this study is on the root causes of delay in infrastructure projects. Many construction projects suffer from delay. Suspension means stoppage of work directed to the contractor by a form from the client, while delay is a slowing down of work without stopping it entirely. Delays give rise to disruption of work and loss of productivity, late completion of project, increased time related costs, and third party claims and abandonment or termination of contract. It is important that general management keep track of project progress to reduce the possibility of delay occurrence or identify it at early stages.

## **2.Literature Review**

### *2.1.Understanding Time Delays And Disputes In Construction Contracts*

Most of the construction projects are executed through contracts which are generally not easy to comprehend even by professionals. With advancement in technology and mammoth requirement of infrastructure in developing countries like India, there has been increase in size and complexities in the nature of projects. It is causing adverse impacts such as increase in number and frequency of claims and disputes besides time and cost overrun. It is essential to develop a system that can assist the contract administrators to understand and evaluate worth of their claims prior to litigation.

### *2.2.Causes Of Delay In Large Construction Projects*

A survey on time performance of different types of construction projects in Saudi Arabia was conducted to determine the causes of delay and their importance according to each of the project participants, i.e, the owner, consultant and the contractor. The field survey conducted included 23 contractors, 19 consultants, and 15 owners. Seventy three causes of delay were identified during the research. 76% of the contractors and 56% of the consultants indicated that average of time overrun is between 10% and 30% of the original duration. Survey concluded that 70% of the projects experienced time overrun and found that 45 out of 76 projects were delayed.

### *2.3. Delays And Cost Overruns In Infrastructure Projects: An Enquiry Into Extents Causes And Remedies*

Media reports abound on instances of prolonged delays and excessive cost overruns in infrastructure projects. Only a small number of projects get delivered in time and within the budget. Examples of successful project implementation of Delhi Metro Rail, are few and appear only far in between. Indeed, the problem of time and cost overruns in India is widespread and severe. Yet, very few empirical studies exist on the subject. Even rarer are the studies based on completed projects. The study investigates various issues related to delays and cost overruns in publically funded infrastructure projects.

### **3. Methodology**

The research through literature reviews and discussion with some parties involved in the construction industry identified a total of 73 causes which are mainly effecting in the delay of construction projects. A questionnaire was developed in order to evaluate the frequency of occurrence, severity and importance of the identified causes.

Data were gathered through a survey, analyzed by using frequency, severity and importance indices, taking in view owners, contractors and consultants. Agreement on the ranking of the importance of the causes of delay between each two groups of parties was also tested. Recommendations for minimizing delay in construction projects were emphasized in view of the results of the study.

#### *3.1. Questionnaire Design*

Data were gathered through a questionnaire. The questionnaire is divided into two main parts. Part 1 is related to general information for both the company and respondent. Both contractors and consultants were further requested to answer questions pertaining to their experience in the construction industry and their opinions about the percentage average time delay in projects they experienced. Part 2 includes the list of the identified causes of delay in construction project. These causes are classified into nine groups according to the sources of delay: factors related to project, owner, contractor, consultant, design-team, materials, equipment, manpower (labor), and external factors.

For each factor or cause two questions were asked: What is the frequency of occurrence for this cause? & What is the degree of severity of this cause in project delay? Both frequency of occurrence and severity were categorized as follows: always, often,

sometimes and rarely (on 4 to 1 point scale). Similarly, degree of severity was categorized as follows: extreme, great, moderate, and little (on 4 to 1 point scale).

### 3.2. Data Analysis Approach

The collected data were analyzed through the following statistical techniques and indices:

- Frequency Index: A formula is used to rank causes of delay based on frequency of occurrence as identified by the participants.
- Frequency Index =  $\left( \sum (a \cdot n) \div N \right) \times (100 \div 4)$
- Where a is the constant expressing weighting given to each response (ranges from 1 for rarely up to 4 for always), n is the frequency of the responses, and N is the total number of responses.
- Severity Index: A formula is used to rank causes of delay based on severity of occurrence as identified by the participants.
- Severity Index =  $\left( \sum (a \cdot n) \div N \right) \times (100 \div 4)$
- Where a is the constant expressing weighting given to each response (ranges from 1 for little up to 4 for severe), n is the frequency of the responses, and N is the total number of responses.
- Importance Index: The importance index of cause is calculated as a function of both frequency and severity indices, as follows:
- Importance Index (I.I%) =  $(\text{Frequency Index} \% \times \text{Severity Index} \%) \div 100$

## 4. Questionnaire Format

### 4.1. Questionnaire Form For Delay Analysis In Infrastructure Projects

This Questionnaire focuses on the study of causes of delay in Infrastructure construction projects. This questionnaire consists of 73 causes of delay on which a detailed analysis will be carried out by using statistical concept. These causes are classified into nine groups according to the sources of delay: Factors related to project, owner, contractor, consultant, design-team, materials, equipment, manpower (labor), and external factors.

#### 4.2. Details To Be Filled By The Respondent

Name:

Date:

Address:

Organization:

Designation:

Work Experience:

Contact No:

Email Id:

For each factor or cause two questions were asked :What is the frequency of occurrence for this cause? &What is the degree of severity of this cause in project delay? Both frequency of occurrence and severity were categorized as follows: always, often, sometimes and rarely (on 4 to 1 point scale). Similarly, degree of severity was categorized as follows: extreme, great, moderate, and little(on 4 to 1 point scale). Respondents are required to fill the respective places with only scale points(1,2,3,4) of their opinion.

#### 4.3. Frequency Of Occurrence

- Always(4):Generally occurs in all the projects(70%-100%).
- Often(3): Occurs in 5 to 7 projects out of 10 projects(50%-70%).
- Sometimes(2):Occurs in 1 to 5 projects out of 10 projects(10%-50%).
- Rarely(1):Occurs only 1 time out of 10 projects(>10%).

#### 4.4. Degree Of Severity

- Extreme(4): Greater than 50% increase in cost and time of project.
- Great(3): 25% to 50% increase in cost and time of project.
- Moderate(2): 10% to 25% increase in cost and time of project.
- Little(1): Less than10% increase in cost and time of project.

The nine categories of delay are:

- Delay at Project level.
- Delay due to Owner.
- Delay due to Contractor.

- Delay due to consultant.
- Delay due to Designer.
- Delay due to Material.
- Delay due to Equipment.
- Delay due to labors.
- Delay due to External factors.

The categories mentioned above attached with the factors of delay are prepared in table format, to enquire about the frequency index and severity index rating from the respondents. The obtained results and findings are from Contractor's Perspective.

#### 4.5.Results and Findings

No	Causes of Delay	Group	Frequency Index(%)	Severity Index(%)	Importance Index(%)
1	Original contract duration is too short	<b>PROJECT GROUP</b>	70.45	64.77	45.64
2.	Legal disputes between various parts		61.36	54.55	33.47
3.	Inadequate definition of substantial completion		47.73	48.86	23.32
4	Ineffective delay penalties		35.23	42.05	14.81
5	Types of construction contract (Turnkey,construction only)		62.50	47.73	29.83
6	Type of project bidding and award (negotiation,lowest bidder.)		53.41	39.77	21.24
7	Delay in progress payments by owner	<b>OWNER GROUP</b>	70.45	59.09	41.63
8	Delay to furnish and deliver the site to the contractor by the owner		61.36	60.23	36.96
9	Change orders by owner during construction		59.09	54.55	32.23
10	Late in revising and approving design documents by owner		65.91	59.09	38.96
11	Delay in approving shop drawings and sample materials		54.55	57.95	31.61
12	Poor communication and coordination by owner and other parties		43.18	43.18	18.65
13	Slowness in decision making process by owner		59.09	50.00	29.55
14	Conflicts between joint ownership of the project		44.32	47.73	21.15
15	Unavailability of incentives for contractor for finishing ahead of schedule		56.82	47.73	27.12

16	Suspension of work by owner		38.64	46.59	18.00
17	Difficulties in financing project by contractor	<b>CONTRACTOR GROUP</b>	59.09	57.95	34.25
18	Conflicts in subcontractors schedule in execution of the project		53.41	53.41	28.53
19	Rework due to errors during construction		47.73	57.95	27.66
20	Conflicts between contractor and other parties (consultant and owner)		50.00	44.32	22.16
21	Poor site management and supervision by the contractor		53.41	50.00	26.70
22	Poor communication and coordination by contractor with the other parties		43.18	42.05	18.16
23	Ineffective planning and scheduling of project by contractor		69.32	61.36	42.54
24	Improper construction methods implemented by contractor		51.14	50.00	26.70
25	Delay's in sub-contractor's work		61.36	52.27	32.08
26	Inadequate contractor's work		42.05	42.05	17.68
27	Frequent change of sub-contractor's because of their inefficient work		47.73	39.77	18.98
28	Poor qualification of the contractor's technical staff		47.73	44.32	21.15
29	Delay in site mobilization		52.27	51.14	26.73
30	Delay in performing inspection and testing by consultant		<b>CONSULTANT GROUP</b>	42.05	42.05
31	Delay in approving major changes in the scope of work by consultant	52.27		51.14	26.73
32	Inflexibility of consultant	61.36		48.86	29.98
33	Poor communication/coordination between the consultant and other parties	60.23		50.00	30.11
34	Late in reviewing and approving design documents by consultant	59.09		53.41	31.56
35	Conflicts between consultant and design engineer	50.00		48.86	24.43
36	Inadequate experience of consultant	34.09		48.86	16.66
37	Mistakes and discrepancies in design documents	<b>DESIGN GROUP</b>	56.82	60.23	34.22
38	Delays in producing design documents		52.27	43.18	22.57
39	Unclear and inadequate details in drawings		52.27	53.41	27.92
40	Complexity of project design		51.14	54.55	27.89
41	Insufficient data collection and survey before design		45.45	54.55	24.79

42	Misunderstanding of owner's requirements by design engineer		45.45	52.27	23.76
43	Inadequate design team experience		39.77	61.36	24.41
44	Un-use of advanced engineering design software		52.27	44.32	23.17
45	Shortage of construction materials in market	<b>MATERIAL GROUP</b>	59.09	65.91	38.95
46	Changes in material types and specifications during the construction		60.23	62.50	37.64
47	Delay in material delivery		65.91	63.64	41.94
48	Damage of sorted material while they are needed urgently		45.45	50.00	22.73
49	Delay in manufacturing special building materials		54.55	54.55	29.75
50	Late procurement of materials		54.55	54.55	29.75
51	Late in selection of finishing materials due to availability of many types in market		54.55	59.09	32.23
52	Equipment Breakdowns		<b>EQUIPMENT GROUP</b>	62.50	59.09
53	Shortage of equipment	61.36		52.27	32.08
54	Low level of equipment-operator's skill	50.00		59.09	29.55
55	Low productivity and efficiency of the equipment	51.14		47.73	24.41
56	Lack of high technology mechanical equipment	52.27		44.32	23.17
57	Shortage of labor	<b>LABOUR GROUP</b>	71.59	67.05	48.00
58	Unqualified workforce		60.23	67.05	40.38
59	Nationality of labors		43.18	40.91	17.67
60	Low productivity level of labors		59.09	52.27	30.89
61	Personal conflicts among labors		50.00	47.73	23.86
62	Effects of subsurface conditions(eg. Soil,high water table)	<b>EXTERNAL GROUP</b>	76.14	77.27	58.83
63	Delay in obtaining permits from municipality		64.77	64.77	41.96
64	Hot weather effect on construction activities		54.55	48.86	26.65
65	Rain effect on construction activities		50.00	56.82	28.41
66	Unavailability of utilities in site (such as water,electricity,telephone, etc)		44.32	42.05	18.63
67	Effect of social and cultural factors		43.18	37.50	16.19
68	Traffic control and restriction at job site		40.91	43.18	17.67
69	Accident during construction		42.05	47.73	20.07
70	Different site(ground) conditions		53.41	47.73	25.49



71	Changes in government regulations and laws		42.05	45.45	19.11
72	Delay in providing services from utilities(such as water, electricity)		47.73	43.18	20.61
73	Delay in performing final inspection and certificate by a third party		42.05	37.50	15.77

Table 1

	<b>Extremely critical</b>
	<b>Very critical</b>
	<b>critical</b>

## 5. Conclusion

The first step in reducing the delays in infrastructure construction project is to understand the root causes of the delay. The results provide a listing of root causes and issues that are directly responsible for most infrastructure construction project delays. Additionally, it is found that fundamental principles must be adopted before significant improvements can be made. The data were collected from the following construction Infrastructure companies

HCC-1, HCC-2, PATEL, PUNJ LOYD, SIMPLEX-R, AKSHAY, SOMA, VIJAY NIRMAN, M&M, AGRASEN, UNIQUE, ICT, ADANIPOWER, HCC-S3, HCC-BWSL, L&TECC, SHREEBUILDCON, SIMPLEXS, UNITY, SLIPCO, SAIL, SIMPLEX GUHATY

### 5.1. Findings And Conclusion

The below are the following important critical causes of delay from contractor's perspective and suitable recommendations are given.

<b>PROJECT GROUP</b>	Original contract duration is too short	I.I=45.64%	Extremely Critical
	Legal dispute between various parties	I.I=33.47%	Very Critical
	Type of construction contract	I.I=29.83%	Critical
<b>OWNER GROUP</b>	Delay in progress payment by owner	I.I=41.63%	Extremely Critical
	Late revision and approval by owner	I.I=38.95%	Very Critical
	Delay in giving site to contractor	I.I=36.96%	Critical

<b>CONTRACTOR GROUP</b>	Ineffective planning and scheduling	I.I=42.54%	Extremely Critical
	Difficulty in financing by contractor	I.I=34.25%	Very Critical
	Delay in subcontractor work	I.I=32.08%	Critical
<b>CONSULTANT GROUP</b>	Late revision and approval by consultant	I.I=31.56%	Extremely Critical
	Poor communication	I.I=30.11%	Very Critical
	Inflexibility of consultant	I.I=29.98%	Critical
<b>DESIGN GROUP</b>	Mistakes & discrepancies in design document	I.I=34.22%	Extremely Critical
	Unclear & inadequate details in drawings	I.I=27.92%	Very Critical
	Complexity of the project design	I.I=27.89%	Critical
<b>MATERIAL GROUP</b>	Delay in material delivery	I.I=41.94%	Extremely Critical
	Shortage of material in market	I.I=38.95%	Very Critical
	Changes in material type and specification	I.I=37.64%	Critical
<b>EQUIPMENT GROUP</b>	Equipment breakdown	I.I=36.93%	Extremely Critical
	Shortage of equipment on site	I.I=32.03%	Very Critical
	Low level skill of operator	I.I=29.55%	Critical
<b>LABOUR GROUP</b>	Shortage of labor	I.I=48.00%	Extremely Critical
	Unqualified work force	I.I=40.38%	Very Critical
	Low productivity	I.I=30.89%	Critical
<b>EXTERNAL GROUP</b>	Effects of subsurface condition	I.I=58.83%	Extremely Critical
	Delay in getting permit from municipality	I.I=41.96%	Very Critical
	Rain effect on site	I.I=28.41%	Critical

Table 2: Results: Importance Index(I.I=%)&Degree of criticality

## 6.Recommendation

The following points can be recommended by all parties in order to minimize and control delays in construction projects:

*6.1.Owner's Should Give Special Attention To The Following Factors*

- Pay progress payment to the contractor on time because it impairs the contractor's ability to finance the work.
- Minimize change orders during construction to avoid delays.
- Avoid delay in reviewing and approving of design documents than the anticipated.
- Check for resources and capabilities, before awarding the contract to the lowest bidder.

*6.2.Contractor's Should Consider The Following Factors*

- Shortage and low productivity of labor: enough number of labors should be assigned and motivated to improve productivity.
- Financial and cash flow problems: contractor should manage his financial resources and plan cash flow by utilizing progress payment.
- Planning and scheduling: they are continuing process during construction and match with the resources and time to develop the work to avoid cost overrun and disputes.
- Site management and supervision: administrative and technical staff should be assigned as soon as project is awarded to make arrangements to achieve completion within specified time with the required quality and estimated cost.

*6.3.Consultant's Should Look To The Following Factors*

- Reviewing and approving design documents any delay caused by the consultant engineer in checking, reviewing and approving the design submittals prior to construction phase, could delay the progress of the work;
- Inflexibility: Consultants should be flexible in evaluating contractor works. Compromising between the cost and high quality should be considered.

*6.4.Architect/Design Engineer Should Focus On The Following Factors*

- Producing design documents on time: Architect or engineer should set a schedule to complete design documents on time, otherwise result in a delay of work completion.

- Mistakes and discrepancies in design documents: They are common reasons for redoing and drawings and may take a long time to make necessary corrections.

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