

# Methodology to analyse Delay and its impact on construction project

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**Abstract** - Delays are unique one in every of the largest issues construction companies are facing today. Present study works on identification of causes of delay in residential construction projects in Indian context. Delays are one of the biggest problems facing by the construction industry. The delays in construction projects have significant financial and social impact to all parties involved in the projects. The aim of the paper is to analyze the causes of delay in Indian construction projects by identifying and ranking the delay factors. A comprehensive literature is conducted to build up the general knowledge required to identify the potential delay factors in different countries. The delay factors are ranked using Relative index and the frequency of occurrence and severity scale. The literature survey result exposed that the construction projects in the developing countries suffer more delay than the developed countries. Questionnaire survey list is prepared depending on the literature review for determining Relative and the probability and the severity for the main causes of delay in construction and distributed to construction Firms that are selected randomly.

**Key Words:** Construction delay, Delay analysis, Questionnaire, Delay factors, Relative importance index, Importance index.

## 1. INTRODUCTION

Now a days Construction delay is a major problem facing by the construction industry. Delay can be defined as the time overrun either beyond completion date specified in a contract or beyond the date that the parties agreed upon for delivery of a project. In most construction projects, there are delays and their impact level varies from project to project ranging from a few days to years. It is a project slipping over its planned schedule and is considered as one of the common problem in construction projects. It is generally understood that the construction delay is the most critical factors affecting to deliver the project in time, within budget, and expected quality. To the owner, delay means loss of revenue through lack of production facilities and rentable space or a dependence on present facilities. It can be found rarely that a project was completed within the specified time.

Delays on construction projects are a universal phenomenon. They are almost always accompanied by cost and time overruns. Construction project delays have an adverse effect on parties (developer, contractor, and consultant) to a contract in terms of a growth in adversarial relationships, distrust, litigation, arbitration, cash-flow

problems, and a general feeling of apprehension towards each other. So, it is essential to define the actual causes of delay in order to minimize and avoid the delays in any construction project.

### 1.1 Objective

The main objectives of this study include the following:

- To identify the causes of delay in Construction Projects through Literature review.
- To categorize the schedule delay factors in construction projects
- To suggest the methodology to work out the importance by different techniques.
- To prepare a Questionnaire based on literature review.
- To conduct a Questionnaire Survey among the construction firms to identify the delay causes and rank them by RII (Relative importance index) method and by IMPI (Importance Index) method.
- Ranking of the factors and groups according to their importance level on schedule delay.

## 2. LITERATURE REVIEW

A number of previous studies have been carried out to determine the causes of delay in construction projects.

Alwi and Keith (2003)[1] did survey for identifying the important causes of delays in building Construction projects in Indonesia. A questionnaire survey was carried out targeting 89 respondents from large contractors and 23 respondents from small contractors. The respondents were asked to assess the level of effect the 31 potential delay causes on their projects.

The delay factors were grouped into six major groups. The results showed that the large and small contractors generally agree on the importance ranking of the individual delay variables. In relation to the groups of the delay variable, however, the result showed that there is no agreement between the two groups of contractors. The professional management group was ranked the highest and the external groups were ranked the lowest by large contractors. Whereas, small contractors ranked the design and documentation group as the highest and the execution group as the lowest.

Ahsan and Gunawan (2010) made a separate study comparing the performance of international development projects in India, China, Bangladesh, and Thailand, in which they reported that construction projects in India showed the worst schedule performance. The study found that in India average schedule overrun is the highest (55% of actual schedule) compared to the other nations. Shebob.A, Dawood.N and Xu.Q (2011) made a Comparative study b/w Libya and UK construction project through questionnaire survey. The delay factors were ranked using the frequency of occurrence and severity scale. The survey result exposed that the construction projects in the developing countries suffers more delay than the developed countries due to lack of technology in the developing countries. Towhid Pourrostan and Amiruddin Ismail (2012) related the field of causes of delay in construction projects has been reviewed over the last decade through a questionnaire survey conducted in Iranian to solicit the causes of delay from consultants and contractors' viewpoint.

Doloi H. et al.(2012) [2] did research to analyze factors affecting delays in Indian construction projects. They selected set of 45 attributes. Their research first identified the key factors impacting delay in Indian construction industry and then established the relationship between the critical attributes for developing prediction models for assessing the impacts of these factors on delay. A questionnaire and personal interviews have formed the basis of their research. Factor analysis and regression modeling were used to examine the significance of the delay factors. From the factor analysis, most critical factors of construction delay were identified as lack of commitment followed by inefficient site management and poor site coordination ranked third.

Ibrahim Mahamid (2013) conducted a survey on time performance of different types of construction projects in Saudi Arabia to determine the causes of delay and their importance according to each of the project participants, i.e, the owner, consultant and the contractor. Then finally he concluded that 76% of the contractors and 56% of the consultants indicated that average of time overrun is between 10% and 30% of the original duration and also found 70% of the projects experienced time overrun in Saudi (i.e. 53 out of 76 projects).

Ogunlana et al., [11] studied the delays in building projects in Thailand, as an example of developing economies. They concluded that the problems of the construction industry in developing economies could be nested in three layers: (1) problem of shortages or inadequacies in industry infrastructure, mainly supply of resources; (2) problems caused by clients and consultants; and (3) problems caused by incompetence of contractors.

Anu V. Thomas and J. Sudhakumar (2014) [3] mentioned that low productivity leads to delays in construction and reported the results of questionnaire survey made to identify the factors influencing construction labour productivity with the project managers, site

engineers, supervisors and craftsmen, in the state of Kerala, India, and also mentioned timely availability of materials at the worksite, delayed material delivery by the supplier, strikes called by political parties or hartals, frequent revisions of drawings/design, resulting in additional work/rework and timely availability of drawings at the worksite as a significant impact on labour productivity. Nitin Chaphalkar and K. C. Iyer (2014) said, in some cases disputes may raise b/w the stakeholders during the construction phase, in which if it's not handled properly, tend to consume time and money of the parties disputing, which leads the project to extended stay.

Prakash Rao and Joseph Camron Culas (2014)[4] had concluded that, ineffective planning & scheduling of project, delays in site mobilization and delay in sub-contractor's work are three most critical factors caused by the contractor, affecting the project performance, followed by client's contributing factors such as delay to furnish & deliver the site, late in revising & approving design documents. Owolabi James et.al (2014)[5] used random sampling technique to list out the most significant causes of delays in construction project. From the survey they observed that 51% of the delays are caused by the client, followed by the contractor with 36% and the consultant with 13%. ARC document solutions (2015) study shows that the problems with document management is a major source of delays and time overrun on construction projects.

### 3. RESEARCH METHODOLOGY

The research methodology for this study contains two stages. The first stage involves Literature search and review. The literature review was conducted through International Project Management Journals, books, conference proceedings and Internet. As the outcome of this review, 42 causes of delay were identified suitable to the present study. These causes were then grouped under nine different categories namely Project Related, Owner related, Contractor related, Consultant related, Design related, Material related, Equipment related, labour related and External factors depending on their nature and mode of occurrence.

The second stage was analytical which first involved the preparation of a questionnaire based on two different approaches used for giving ranking to causes of delay of Residential construction projects. This study suggests two different techniques: Relative Importance Index (RII) and Importance Index (II). In the first technique, Relative importance of each cause of delay can be calculated while in the second technique, Importance index is calculated as a function of frequency and severity indices.

### 4. DATA COLLECTION

The target population for this study included Civil Engineering and building construction firms of Navi-Mumbai region. The Clients, Contractors and Consultants of

this region were targeted for the survey. The details of various firms and their contacts were obtained through internet and personal references. Since the population size was unknown, Google Z Score test was used to calculate the sample size.

$$\text{Sample Size} = \frac{(z\text{-score})^2 \times (\text{std.deviation}) \times (1 - \text{std.deviation})}{(\text{Margin of error})^2}$$

Where z-score is the statistic value for the confidence interval used, i.e., 2.575, 1.96 and 1.645 for 99%, 95% and 90% confidence levels respectively. Taking confidence interval as 90%, i.e., 10% significance level, standard deviation as 10% & margin of error as 10%, the sample size of the population is calculated as follows:

$$\text{Sample size} = \frac{(1.65^2) \times (0.1) \times (1 - 0.1)}{(0.1)^2} = 25 \text{ samples}$$

These 25 samples of responses are to be collected from Clients, Contractors and Consultants equally. As the response rate is very low, the questionnaire was distributed to the various parties more than the sample size requirement. A total of 30 questionnaires will distributed to different respondents. Timely reminders will also be required. The results of this chapter will demonstrate the ranking of the factors and groups according to their importance level on schedule delay.

The following two types of approach should be used for data analysis.

A. Relative Importance Index technique: Kometa et al used the Relative Importance Index method to determine the relative importance of the various causes and effects of delays. The same method is going to adopted in this study within various groups (i.e. clients, consultants or contractors). The four-point scale ranged from 1 (not important) to 4 (extremely important) will be adopted and will be transformed to relative importance indices (RII) for each factor as follows:

$$\text{RII} = \frac{\sum W}{A * N}$$

Where, W is the weighting given to each factor by the respondents (ranging from 1 to 4), A is the highest weight (i.e. 4 in this case), and N is the total number of respondents.

The RII value had a range from 0 to 4 (0 not inclusive), higher the value of RII, more important was the cause of delays. The RII was used to rank (R) the different causes. Each individual cause's RII perceived by all respondents should be used to assess the general and overall rankings in order to give an overall picture of the causes of construction delays in Indian construction industry.

B. Importance Index technique: In this technique, For each cause/factor two questions should be asked: What is the frequency of occurrence for this cause? And what is the degree of severity of this cause on project delay? Both frequency of occurrence and severity were categorized on a four-point scale. Frequency of occurrence is 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). Frequency index: A formula is used to rank causes of delay based on frequency of occurrence as identified by the participants.

$$\text{Frequency Index (F.I.) (\%)} = \frac{\sum a (n/N) * 100}{4}$$

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 total number of responses.

Severity index: A formula is used to rank causes of delay based on severity as indicated by the participants.

$$\text{Severity Index (S.I.) (\%)} = \frac{\sum a (n/N) * 100}{4}$$

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 total number of responses.

Importance index: The importance index of each cause is calculated as a function of both frequency and severity indices, as follows:

$$\text{Importance Index (IMP.I.) (\%)} = \frac{[\text{F.I. (\%)} * \text{S.I. (\%)}]}{100}$$

## 5. RECOMMENDATION

Based on the above literature the following points can be recommended by all parties in order to minimize and control delays in construction projects

### 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.

## 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.

## 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.

## 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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