# Causes of Delay in Construction Projects: An Empirical Study

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***Abstract:*** The objective of the present study was to explore the causes of delay in construction projects. Effects of various delaying factors related to the contractor, client/owner, consultant, material, equipment, labor and general environment factors on delay in constructions projects have been measured. Data on the study variables has been collected through structured questionnaire from thirty seven Construction Company. Participants were approached personally to collect the data. Various statistical tools such as reliability test, factor analysis and regression have been applied for data analysis and inference. The results of the study reveal that the factors related to contractor, client, consultant, material and equipment have significant impact on delay in construction project whereas labor and general environment factors found to have no effects on delay. The findings of the study provide significant insights to construction industry so that they may formulate strategies in order to avoid delay and its consequences. The recommendations and limitations are also discussed in the conclusion part of the study.

Keywords: Indian Construction Industry, Questionnaire, Relative Index Importance, Cronbach's Alpha Test**,** Delay.

## 1. INTRODUCTION

Delay is the most critical factor in overall performance of any construction project because it increases the cost of the project. Completing design on time is salutary for all the parties involved in the design like Adviser, Customer and the Contractor. Thus it's necessary to identify the factors responsible for schedule detention in construction systems. Time is a constituent element of each and every plan that a company schedule to perform a task or a design. There's strong relationship between design compass, time and conditions. A single change in any of above mentioned areas affects the overall performance of the design. Delay is considered as expensive for proprietor as well as for construction establishment. Where proprietor lose the implicit profit while exercising the systems and advanced cost for maintaining the contract, the contractors lose openings for unborn design due to engagement in current systems. General public also suffer due to detention in construction of roads, flyovers and structures. Time and cost have strong relationship as the increase in time will tend to lead to the cost- overrun. Time is bandied as critical coffers and it should be managed until the launch of the design. Delay and its consequences are considered as one of the supreme adverse factor in Indian construction assiduity

## II. OBJECTIVES

The main objectives of this study include the following:

- To identify the causes of delay in construction projects.
- To minimize the effect of delay in construction project.

## . III. LITERATURE REVIEW

**Raut S. P.1 , Gohatre V. S. 2 , Nistane H.P (2014) -**. During construction, the delay may be defined as exceeding the completion date specified in the contract or exceeding the date on which the parties agreed to the delivery of the project. The purpose of this paper is to examine ways to minimize

the cause of build delays. Project delays include several factors such as missing funds, changes in the drawings, lack of effective communication and inadequate project management.

**Madan Kumar Sha, et.al (2015)-** The overall objective of the this research paper is 'To explore all the important factors contributing the cost overrun and identifying the critical factors of cause and effect of delay in construction project. Consultants and Contractors have been interviewed personally to get the practical problems through a survey questionnaire. The answers have been grouped and suitable methodologies for solving the problems have been formulated which are suitable for our Nepali Scenario.

**Shabbab Al Hammadi1, M. Sadique Nawab (2016)** -Due to unexpected problems encountered during Conception, designing & construction phase often led to unwanted delay in project completion. A survey was conducted in Saudi Arabia to determine exact factors responsible for project delay. This was achieved by carrying a critical analysis of the literature and carrying out a questionnaires survey among consultants, project managers and engineers involved in construction projects and collecting their responses. The importance of Project owner's role, contractor related, Financing related, Materials related, Design documents have been cited as main delay factors.

**Shruthi Sivaprakasam, S.Dinesh, J. Jayashree (2017) -** Construction Delays are the time overrun either beyond date specified in a contract. Delays exceed initial time and cost estimates. Delays can be minimized only when their causes are identified and analyzed. The causes of delay in construction projects are taken from the past literature review. The literature reviews are summarized and various causes related to the delays based on literature review summary.

**Mohammad Al-Mohammad ,Omar Bin Jamaludin (2018)-** This review also discussed the groups causing delay based on the source of delay. The top five delay factors related to contractor, owner and consultant have been discussed within each category. This paper revealed that previous researches are regarded as the main source for causes of delay identification. Moreover, questionnaire and the relative importance index are the most frequent methods for collecting data and ranking delay factors, respectively.

**Mohd Danish, Dr. Syed Khursheed Ahmad (2019)** - This paper study has carried out based on literature review and a questionnaire survey. The eighty-three questionnaire has been made on the basis of pilot study, which has been distributed on various construction sites. Interview has been taken on each construction sites, also take photos of any ongoing activity on that site. Then ranked on their importance index by the data collection in India.

**Ludwig Rivera , Hilario Baguec, Jr. and Chunho Yeom *(2020)-** This study aims to determine the ten principal causes of delay in road construction projects in twenty five developing countries across the globe. The study involves two steps. First, the authors compiled information regarding the most frequent delays in a road construction project. Second, they analyzed the intensity of each cause of delay in these projects. Being more accurate in the methodology, given the nature of the information, the researchers used a quasi-meta-analysis for processing the data. Half (50%) of the countries have similar causes of delay, and likewise, 50% of the countries identified the top ten primary causes of delay in road construction projects based on the intensity results.

**Mr. Aishwarya Avinashe.1, Prof. S.Sabihuddin (2021)** -The project includes construction As a result, in this the purpose of this study is to fill in a critical information gap. By identifying various factors that cause construction problems and using them as a starting point, we consider the construction of objects, housing construction. Provided are the results of a survey that was conducted on the relative importance of entrepreneurs and consultants that were determined using the Relative Importance Index. (RII)

## IV. METHODOLOGY

A questionnaire survey was conducted by construction professionals representing various stakeholders involved in construction projects in India.

### *A*. Questionnaire Design

The questionnaire was designed based on critical factors were identified that contributed to the causes of risks. A questionnaire survey was developed to assess the perceptions of various construction professionals of the relative importance of causes and the effects of construction risks. The questionnaire was designed into two sections: Section A; section B. Section A is to obtain the requested background information about the respondents. Section B is to obtain information on the factors that contribute to the causes of delay in construction projects from the perspective of construction professionals. A total forty three resources related factors were identified under seven broad categories. A five point Likert scale (1 very low, 2 low, 3 moderate, 4 high, 5 very high) was adopted where respondents were asked to rank the importance and impact of a particular factor on risks in one of their selected projects.

### B Analysis of Data

The data obtained was analyses to determine the relative importance of the various factors that contribute to causes of construction delays.

**RELATIVE IMPORTANCE INDEX (RII)**

Assess the relative significance among risks, previous literature work study suggests establishing a risk significance index by calculating a significance score for each risk. For Calculating the significance score, multiply the probability of occurrence by the degree of Impact. The significance score for each risk assessed by each respondent can be obtained through the model.

$$S^{i}_{j} = {}^{i}_{A\,j} * B_{j}^{\,i}$$

Where

$S^{i}_{j}$ = Significance score assessed by respondent j for risk i

$A^{i}_{j}$ = Occurrence of risk i, assessed by respondent j

$B^{i}_{j}$ = degree of impact of risk I, assessed by respondent j.

By averaging scores from every one of the reactions, it is conceivable to get a normal importance score for each hazard, and this normal score is known as the hazard record score and is utilized for positioning the dangers. The model for the figuring of hazard list score can be characterized as

$$\mathbf{R_s^i = \sum_j^T = 1\ S^i_j / T}$$

Where $R_s^i$ = index score for risk i

$S^{i}_{j}$ = Significance score assessed by respondent j for risk i

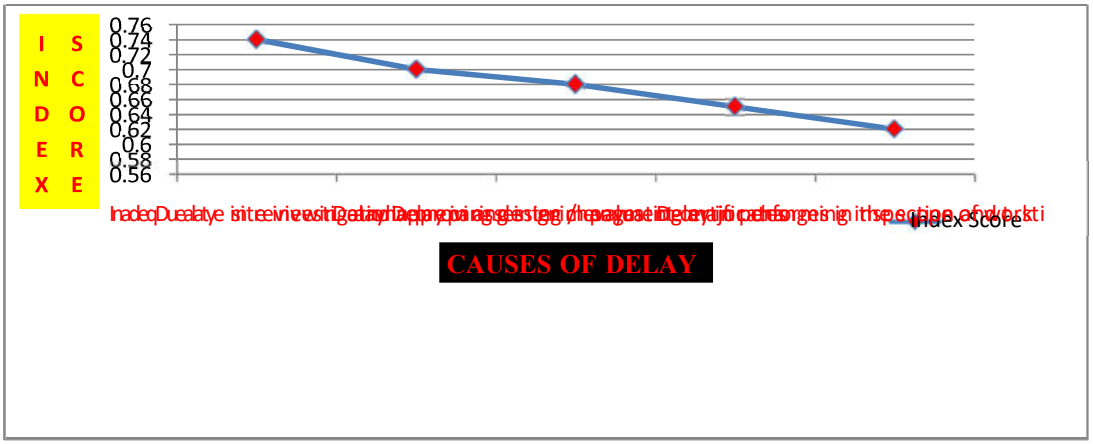
T= total number of responses

| Questionnaire Result Sheet | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DELAY FACTORS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | Total | Mean | SD(s) | C.O.V =(s/m) |
| Delay in assessing / Evaluating major changes in the scope of work | 0.6 | 0.8 | 0.4 | 0.8 | 0.8 | 0.6 | 0.6 | 0.6 | 0.8 | 0.6 | 0.4 | 0.6 | 0.8 | 0.4 | 0.8 | 0.4 | 0.8 | 0.8 | 0.6 | 0.8 | 13 | 0.7 | 0.1 | 0 |
| inadequate site investigation | 0.8 | 0.8 | 0.8 | 1 | 0.4 | 0.6 | 0.6 | 0.8 | 1 | 0.6 | 0.8 | 0.6 | 1 | 0.8 | 0.8 | 0.8 | 1 | 0.4 | 0.6 | 0.6 | 15 | 0.7 | 0.1 | 7.4 |
| Delay in reviewing and approving design changes | 0.8 | 0.8 | 1 | 0.8 | 0.4 | 0.6 | 0.4 | 0.8 | 0.8 | 0.6 | 0.8 | 0.6 | 0.8 | 0.8 | 0.8 | 1 | 0.8 | 0.4 | 0.6 | 0.4 | 14 | 0.7 | 0.2 | 3.5 |
| Delay in performing inspection and testing | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.8 | 0.4 | 0.6 | 0.6 | 0.8 | 0.6 | 0.8 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.8 | 0.4 | 12 | 0.6 | 0.1 | 6.2 |
| Delay in preparing interim payment certificates | 0.8 | 0.8 | 1 | 0.8 | 0.2 | 0.6 | 0.4 | 0.8 | 0.8 | 0.6 | 0.8 | 0.6 | 0.8 | 0.8 | 0.8 | 1 | 0.8 | 0.2 | 0.6 | 0.4 | 14 | 0.7 | 0.2 | 3.4 |
| Ineffective planning and scheduling of project | 1 | 0.6 | 0.4 | 0.8 | 0.4 | 0.6 | 0.6 | 1 | 0.8 | 0.6 | 1 | 0.6 | 0.8 | 1 | 0.6 | 0.4 | 0.8 | 0.4 | 0.6 | 0.6 | 14 | 0.7 | 0.2 | 3.4 |
| Delay in site mobilization | 0.8 | 0.8 | 0.8 | 0.8 | 0.2 | 0.4 | 0.8 | 0.8 | 0.8 | 0.4 | 0.8 | 0.4 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.2 | 0.4 | 1 | 13 | 0.7 | 0.1 | 6.7 |
| Incompetent project team | 1 | 0.8 | 0.6 | 1 | 0.6 | 0.4 | 0.6 | 1 | 1 | 0.4 | 1 | 0.4 | 1 | 1 | 0.8 | 0.6 | 1 | 0.6 | 0.4 | 0.6 | 15 | 0.7 | 0.2 | 3.7 |
| Inefficient pricing tender | 0.8 | 0.8 | 0.8 | 0.8 | 0.4 | 0.6 | 0.4 | 0.8 | 0.8 | 0.6 | 0.8 | 0.6 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.4 | 0.6 | 0.4 | 14 | 0.7 | 0.2 | 3.4 |
| poor site management and supervision | 0.8 | 0.8 | 0.8 | 0.8 | 0.2 | 0.4 | 0.6 | 0.8 | 0.8 | 0.4 | 0.8 | 0.4 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.2 | 0.4 | 0.6 | 13 | 0.6 | 0.1 | 6.4 |
| poor procurement of construction materials | 0.8 | 0.8 | 0.8 | 0.8 | 0.4 | 0.6 | 0.4 | 0.8 | 0.8 | 0.6 | 0.8 | 0.6 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.4 | 0.6 | 0.4 | 14 | 0.7 | 0.2 | 3.4 |
| Conflicts between contractor and other parties | 1 | 0.8 | 0.8 | 1 | 0.8 | 0.4 | 0.6 | 1 | 1 | 0.4 | 1 | 0.4 | 1 | 1 | 0.8 | 0.8 | 1 | 0.8 | 0.4 | 0.6 | 16 | 0.8 | 0.2 | 3.9 |
| Inadequate experience of consultant | 0.8 | 0.8 | 0.8 | 0.4 | 0.6 | 0.2 | 0.4 | 0.8 | 0.4 | 0.2 | 0.8 | 0.2 | 0.4 | 0.8 | 0.8 | 0.8 | 0.4 | 0.6 | 0.2 | 0.4 | 11 | 0.5 | 0.2 | 2.7 |
| Delay in performing inspection and testing by | 0.8 | 0.8 | 0.8 | 0.6 | 0.8 | 0.4 | 0.6 | 0.8 | 0.6 | 0.4 | 0.8 | 0.4 | 0.6 | 0.8 | 0.8 | 0.8 | 0.6 | 0.8 | 0.4 | 0.6 | 13 | 0.7 | 0.1 | 6.6 |
| Complexity of project design | 1 | 0.6 | 1 | 0.4 | 0.2 | 0.8 | 0.6 | 1 | 0.4 | 0.8 | 1 | 0.8 | 0.4 | 1 | 0.6 | 1 | 0.4 | 0.2 | 0.8 | 0.6 | 14 | 0.7 | 0.2 | 3.4 |
| Waiting time for approval of tests and inspections | 0.8 | 0.8 | 0.8 | 0.4 | 0.4 | 0.6 | 0.8 | 0.8 | 0.4 | 0.6 | 0.8 | 0.6 | 0.4 | 0.8 | 0.8 | 0.8 | 0.4 | 0.4 | 0.6 | 1 | 13 | 0.7 | 0.1 | 6.5 |
| Inadequate supervision to contractor | 0.8 | 0.8 | 0.8 | 0.6 | 0.4 | 0.4 | 0.6 | 0.8 | 0.6 | 0.4 | 0.8 | 0.4 | 0.6 | 0.8 | 0.8 | 0.8 | 0.6 | 0.4 | 0.4 | 0.6 | 12 | 0.6 | 0.1 | 6.2 |
| Unclear and inadequate details in drawing | 0.8 | 0.8 | 0.8 | 0.6 | 0.2 | 0.4 | 0.6 | 0.8 | 0.6 | 0.4 | 0.8 | 0.4 | 0.6 | 0.8 | 0.8 | 0.8 | 0.6 | 0.2 | 0.4 | 0.6 | 12 | 0.6 | 0.1 | 6 |
| Delay in approving major changes in the scope | 1 | 0.6 | 1 | 0.4 | 0.4 | 0.8 | 0.6 | 1 | 0.4 | 0.8 | 1 | 0.8 | 0.4 | 1 | 0.6 | 1 | 0.4 | 0.4 | 0.8 | 0.6 | 14 | 0.7 | 0.2 | 3.5 |
| Change orders | 0.8 | 0.8 | 0.8 | 0.6 | 0.2 | 0.6 | 0.8 | 0.8 | 0.6 | 0.6 | 0.8 | 0.6 | 0.6 | 0.8 | 0.8 | 0.8 | 0.6 | 0.2 | 0.6 | 0.6 | 13 | 0.7 | 0.1 | 6.5 |
| Delay in payments | 1 | 0.6 | 1 | 0.4 | 0.4 | 0.8 | 0.4 | 1 | 0.4 | 0.8 | 1 | 0.8 | 0.4 | 1 | 0.6 | 1 | 0.4 | 0.4 | 0.8 | 0.4 | 14 | 0.7 | 0.3 | 2.27 |

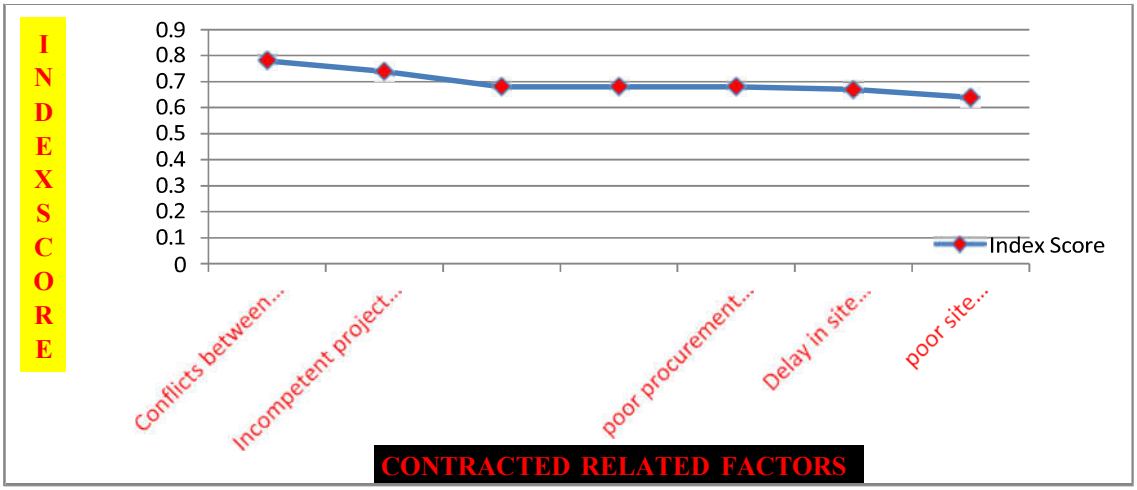
| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Changes in material types and specifications during construction | 0.8 | 0.8 | 0.8 | 0.4 | 0.4 | 0.8 | 0.4 | 0.8 | 0.4 | 0.8 | 0.8 | 0.8 | 0.4 | 0.8 | 0.8 | 0.8 | 0.4 | 0.4 | 0.8 | 0.4 | 13 | 0.6 | 0.2 | 3.2 |
| Slow decision making | 0.8 | 1 | 0.2 | 0.6 | 0.2 | 0.4 | 0.6 | 0.8 | 0.6 | 0.4 | 0.8 | 0.4 | 0.6 | 0.8 | 1 | 0.2 | 0.6 | 0.2 | 0.4 | 0.6 | 11 | 0.6 | 0.1 | 5.6 |
| Unrealistic contract duration | 1 | 0.4 | 0.6 | 0.4 | 0.6 | 0.8 | 0.4 | 1 | 0.4 | 0.8 | 1 | 0.8 | 0.4 | 1 | 0.4 | 0.6 | 0.4 | 0.6 | 0.8 | 0.4 | 13 | 0.6 | 0.3 | 2.13 |
| Delay in approving design documents | 1 | 0.6 | 0.6 | 0.4 | 0.4 | 0.2 | 0.6 | 1 | 0.4 | 0.2 | 1 | 0.2 | 0.4 | 1 | 0.6 | 0.6 | 0.4 | 0.4 | 0.2 | 0.6 | 11 | 0.5 | 0.2 | 2.7 |
| Shortage of Labour Supply | 0.8 | 0.8 | 0.8 | 0.6 | 0.8 | 0.4 | 0.2 | 0.8 | 0.6 | 0.4 | 0.8 | 0.4 | 0.6 | 0.8 | 0.8 | 0.8 | 0.6 | 0.8 | 0.4 | 0.2 | 12 | 0.6 | 0.3 | 2.07 |
| Labor Productivity | 1 | 0.2 | 0.2 | 0.2 | 0.4 | 0.6 | 0.2 | 1 | 0.2 | 0.6 | 1 | 0.6 | 0.2 | 1 | 0.2 | 0.2 | 0.2 | 0.4 | 0.6 | 0.2 | 9.2 | 0.5 | 0.4 | 1.15 |
| Equipment Availability and Failure | 0.2 | 0.2 | 0.4 | 0.2 | 0.8 | 0.4 | 0.8 | 0.2 | 0.2 | 0.4 | 0.2 | 0.4 | 0.2 | 0.2 | 0.2 | 0.4 | 0.2 | 0.8 | 0.4 | 0.8 | 7.6 | 0.4 | 0.3 | 1.27 |
| Weak motivation | 0.4 | 0.4 | 0.6 | 0.4 | 0.6 | 0.2 | 0.8 | 0.4 | 0.4 | 0.2 | 0.4 | 0.2 | 0.4 | 0.4 | 0.4 | 0.6 | 0.4 | 0.6 | 0.2 | 0.8 | 8.8 | 0.4 | 0.2 | 2.2 |
| Lack of skilled labour | 1 | 0.6 | 0.4 | 0.4 | 0.6 | 0.6 | 0.4 | 1 | 0.4 | 0.6 | 1 | 0.6 | 0.4 | 1 | 0.6 | 0.4 | 0.4 | 0.6 | 0.6 | 0.4 | 12 | 0.6 | 0.3 | 2 |
| Presence of Unskilled Labor | 0.4 | 0.6 | 0.6 | 0.8 | 0.4 | 0.8 | 0.6 | 0.4 | 0.8 | 0.8 | 0.4 | 0.8 | 0.8 | 0.4 | 0.6 | 0.6 | 0.8 | 0.4 | 0.8 | 0.6 | 12 | 0.6 | 0.1 | 6.2 |
| Unfavourable weather conditions | 0.2 | 0.4 | 0.2 | 0.4 | 0.6 | 0.4 | 0.6 | 0.2 | 0.4 | 0.4 | 0.2 | 0.4 | 0.4 | 0.2 | 0.4 | 0.2 | 0.4 | 0.6 | 0.4 | 0.6 | 7.6 | 0.4 | 0.2 | 1.9 |
| Regulatory Changes and Building Code | 0.4 | 0.4 | 0.8 | 0.6 | 0.4 | 0.6 | 0.4 | 0.4 | 0.6 | 0.6 | 0.4 | 0.6 | 0.6 | 0.4 | 0.4 | 0.8 | 0.6 | 0.4 | 0.6 | 0.8 | 11 | 0.5 | 0.2 | 2.7 |
| Delay in providing services from utilities (such as water, electricity) | 0.4 | 0.8 | 0.6 | 0.4 | 0.6 | 0.4 | 0.2 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.8 | 0.6 | 0.4 | 0.6 | 0.4 | 0.2 | 9.2 | 0.5 | 0.1 | 4.6 |
| Delay in manufacturing materials | 0.8 | 0.6 | 0.8 | 0.6 | 0.4 | 0.6 | 0.6 | 0.8 | 0.6 | 0.6 | 0.8 | 0.6 | 0.6 | 0.8 | 0.6 | 0.8 | 0.6 | 0.4 | 0.6 | 0.6 | 13 | 0.6 | 0.1 | 6.4 |
| Rain effect on construction activities | 0.8 | 0.8 | 0.4 | 0.4 | 0.6 | 0.8 | 0.6 | 0.8 | 0.4 | 0.8 | 0.8 | 0.8 | 0.4 | 0.8 | 0.8 | 0.4 | 0.4 | 0.6 | 0.8 | 0.6 | 13 | 0.6 | 0.1 | 6.4 |
| Accident during construction | 0.8 | 0.6 | 0.8 | 0.6 | 0.4 | 0.6 | 0.8 | 0.8 | 0.6 | 0.6 | 0.8 | 0.6 | 0.6 | 0.8 | 0.6 | 0.8 | 0.6 | 0.4 | 0.6 | 0.6 | 13 | 0.7 | 0.1 | 6.5 |
| Equipment shortage | 0.2 | 0.4 | 0.2 | 0.4 | 0.6 | 0.4 | 0.6 | 0.2 | 0.4 | 0.4 | 0.2 | 0.4 | 0.4 | 0.2 | 0.4 | 0.2 | 0.4 | 0.6 | 0.4 | 0.6 | 7.6 | 0.4 | 0.2 | 1.9 |
| Wrong selection | 0.2 | 0.2 | 0.4 | 0.4 | 0.6 | 0.6 | 0.4 | 0.2 | 0.4 | 0.6 | 0.2 | 0.6 | 0.4 | 0.2 | 0.2 | 0.4 | 0.4 | 0.6 | 0.6 | 0.4 | 8 | 0.4 | 0.1 | 4 |
| Low efficiency | 0.8 | 0.8 | 0.8 | 0.6 | 0.4 | 0.6 | 0.4 | 0.8 | 0.6 | 0.6 | 0.8 | 0.6 | 0.6 | 0.8 | 0.8 | 0.8 | 0.6 | 0.4 | 0.6 | 0.4 | 13 | 0.6 | 0.2 | 3.2 |
| Equipment delivery problem | 0.8 | 0.8 | 0.8 | 0.4 | 0.6 | 0.4 | 0.8 | 0.8 | 0.4 | 0.4 | 0.8 | 0.4 | 0.4 | 0.8 | 0.8 | 0.8 | 0.4 | 0.6 | 0.4 | 1 | 13 | 0.6 | 0.1 | 6.3 |
| Inadequate skill of operators | 1 | 0.4 | 0.2 | 0.4 | 0.6 | 0.4 | 0.6 | 0.6 | 0.4 | 0.4 | 0.6 | 0.4 | 0.4 | 0.6 | 0.4 | 0.2 | 0.4 | 0.6 | 0.4 | 0.6 | 9.6 | 0.5 | 0.2 | 2.4 |
| Equipment breakdown and maintenance problem | 0.4 | 0.4 | 0.6 | 0.2 | 0.6 | 0.6 | 0.4 | 0.4 | 0.2 | 0.6 | 0.4 | 0.6 | 0.2 | 0.4 | 0.4 | 0.6 | 0.2 | 0.6 | 0.6 | 0.8 | 9.2 | 0.5 | 0.2 | 2.3 |

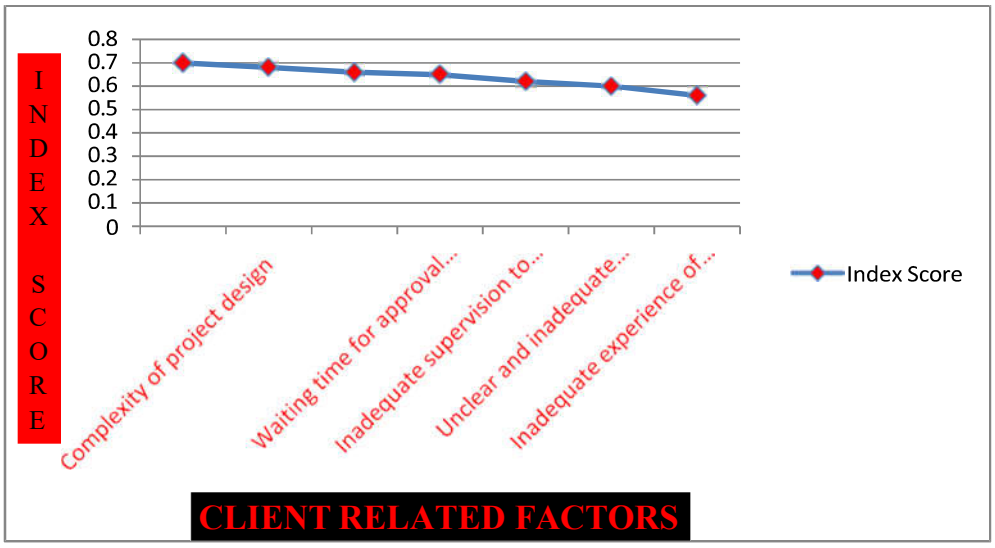
| RANKING OF FACTORS | | | |
|---|---|---|---|
| S.No | Factors | Index Score | Rank order |
| 1 | Conflicts between contractor and other parties | 0.78 | 1 |
| 2 | Inadequate site investigation | 0.74 | 2 |
| 3 | Incompetent project team | 0.74 | 3 |
| 4 | Delay in reviewing and approving design changes | 0.7 | 4 |
| 5 | Delay in approving major changes in the scope | 0.7 | 5 |
| 6 | Delay in preparing interim payment certificates | 0.68 | 6 |
| 7 | Ineffective planning and scheduling of project | 0.68 | 7 |
| 8 | Inefficient pricing tender | 0.68 | 8 |
| 9 | poor procurement of construction materials | 0.68 | 9 |
| 10 | Complexity of project design | 0.68 | 10 |
| 11 | Delay in payments | 0.68 | 11 |
| 12 | Delay in site mobilization | 0.67 | 12 |
| 13 | Delay in performing inspection and testing by | 0.66 | 13 |
| 14 | Accident during construction | 0.65 | 14 |
| 15 | Change orders | 0.65 | 15 |
| 16 | Waiting time for approval of tests and inspections | 0.65 | 16 |
| 17 | Delay in assessing / Evaluating major changes in the scope of work | 0.65 | 17 |
| 18 | poor site management and supervision | 0.64 | 18 |
| 19 | Changes in material types and specifications during construction | 0.64 | 19 |
| 20 | Unrealistic contract duration | 0.64 | 20 |
| 21 | Delay in manufacturing materials | 0.64 | 21 |
| 22 | Rain effect on construction activities | 0.64 | 22 |
| 23 | Low efficiency | 0.64 | 23 |
| 24 | Equipment delivery problem | 0.63 | 24 |
| 25 | Shortage of Labour Supply | 0.62 | 25 |
| 26 | Presence of Unskilled Labor | 0.62 | 26 |
| 27 | Inadequate supervision to contractor | 0.62 | 27 |
| 28 | Delay in performing inspection and testing | 0.62 | 28 |
| 29 | Presence of Unskilled Labor | 0.62 | 29 |
| 30 | Unclear and inadequate details in drawing | 0.6 | 30 |
| 31 | Lack of skilled labour | 0.6 | 31 |
| 32 | Slow decision making | 0.56 | 32 |
| 33 | Delay in approving design documents | 0.54 | 33 |
| 34 | Regulatory Changes and Building Code | 0.54 | 34 |
| 35 | Inadequate experience of consultant | 0.54 | 35 |
| 36 | Inadequate skill of operators | 0.48 | 36 |
| 37 | Labor Productivity | 0.46 | 37 |
| 38 | Equipment breakdown and maintenance problem | 0.46 | 38 |
| 39 | Delay in providing services from utilities (such as water, electricity) | 0.46 | 39 |
| 40 | Weak motivation | 0.44 | 40 |
| 41 | Wrong selection | 0.4 | 41 |
| 42 | Equipment shortage | 0.38 | 42 |
| 43 | Unfavorable weather conditions | 0.38 | 43 |

| S.No | Causes of Delay | Index Score |
|---|---|---|
| 1 | Inadequate site investigation | 0.74 |
| 2 | Delay in reviewing and approving design changes | 0.7 |
| 3 | Delay in preparing interim payment certificates | 0.68 |
| 4 | Delay in assessing / evaluating major changes in the scope of work | 0.65 |
| **5** | Delay in performing inspection and testing | 0.62 |

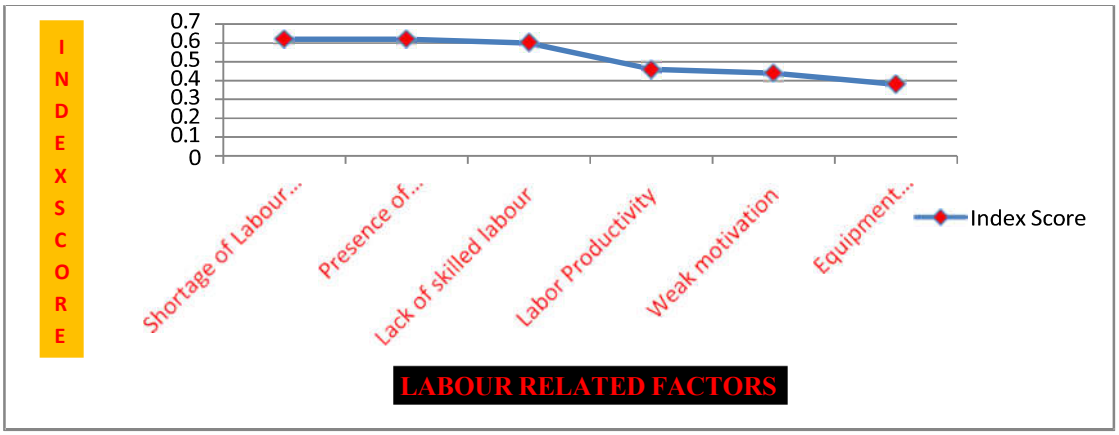



| S.No | CONTRACTED RELATED | Index Score |
|---|---|---|
| 1 | Conflicts between contractor and other parties | 0.78 |
| 2 | Incompetent project team | 0.74 |
| 3 | Ineffective planning and scheduling of project | 0.68 |
| 4 | Inefficient pricing tender | 0.68 |
| 5 | poor procurement of construction materials | 0.68 |
| 6 | Delay in site mobilization | 0.67 |
| 7 | poor site management and supervision | 0.64 |

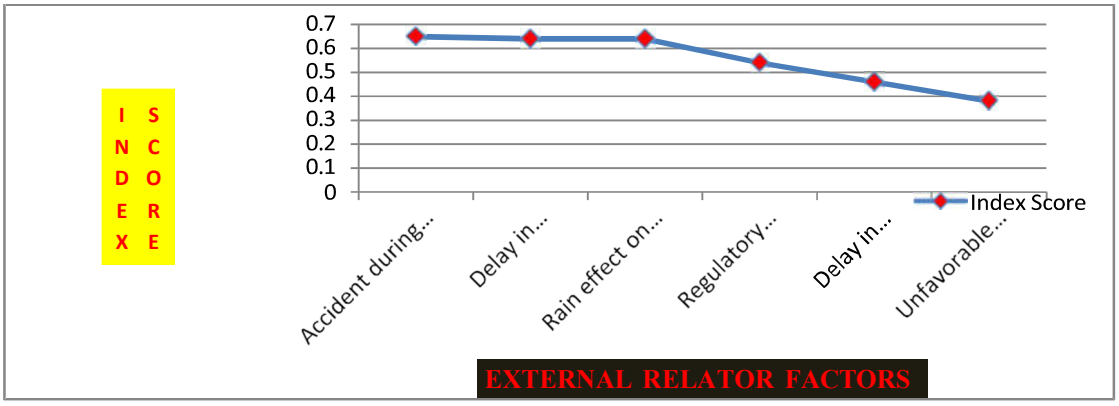


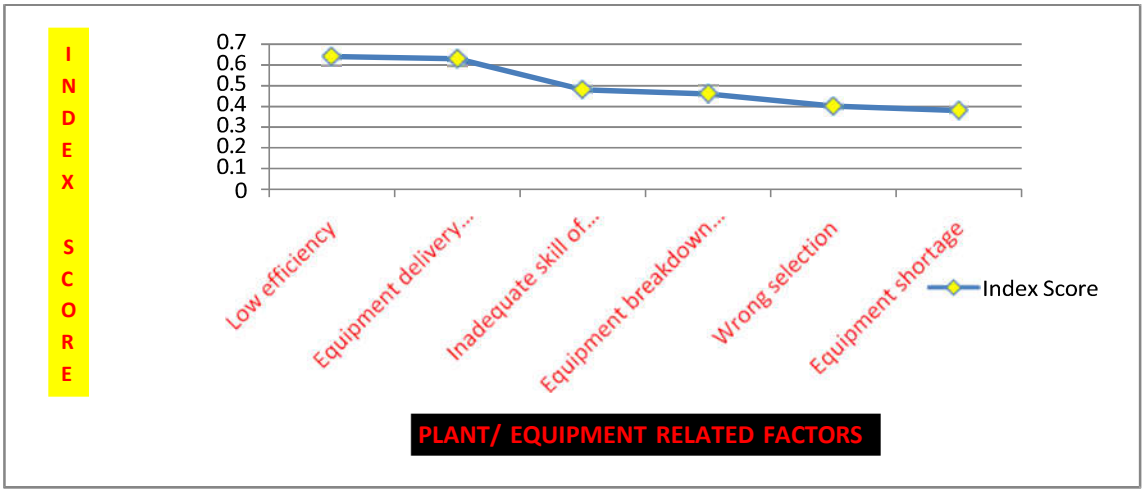

| S.No | LABOUR RELATED | Index Score |
|---|---|---|
| 1 | Shortage of Labour Supply | 0.62 |
| 2 | Presence of Unskilled Labor | 0.62 |
| 3 | Lack of skilled labour | 0.6 |
| 4 | Labor Productivity | 0.46 |
| 5 | Weak motivation | 0.44 |
| 6 | Equipment Availability and Failure | 0.38 |




| S.No | EXTERNAL RELATED | Index Score |
|---|---|---|
| 1 | Accident during construction | 0.65 |
| 2 | Delay in manufacturing materials | 0.64 |
| 3 | Rain effect on construction activities | 0.64 |
| 4 | Regulatory Changes and Building Code | 0.54 |
| 5 | Delay in providing services from utilities (such as water, electricity) | 0.46 |
| 6 | Unfavorable weather conditions | 0.38 |



| S.No | PLANT / EQUIPMENT RELATED | Index Score |
|---|---|---|
| 1 | Low efficiency | 0.64 |
| 2 | Equipment delivery problem | 0.63 |
| 3 | Inadequate skill of operators | 0.48 |
| 4 | Equipment breakdown and maintenance problem | 0.46 |
| 5 | Wrong selection | 0.4 |
| 6 | Equipment shortage | 0.38 |




**Applicability of Cronbach's Alpha Test**

Cronbach's alpha test is applied due to the small data size. Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. A "high" value for alpha does not imply that the measure is unidimensional. In statistics (classical test theory), Cronbach's α(alpha) is the trivial name used for tau-equivalent reliability(ρτ) (as a lower bound) estimate of the reliability of a psychometric test. Cronbach's alpha will generally increase as the inter correlations among test items increase, and is thus known as an internal consistency estimate of reliability of test scores. Because inter correlations among test items are maximized when all items measure the same construct, Cronbach's alpha is widely believed to indirectly indicate the degree to which a set of items measures a single unidimensional latent construct. It is easy to show, however that tests with the same test length and variance, but different underlying factorial structures can result in the same values of Cronbach's alpha. Indeed, several investigators have shown that alpha can take on quite high values even when the set of items measures several unrelated latent constructs.

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum^{k}_{i=1} \sigma y^2}{\sigma x^2}\right)$$

Where,

$\sigma x^2$ is the variance of the observed total test scores = 0

$\sigma y^2$ the variance of component for the current sample of persons = 0

k = no of sample

α = cronbach's alpha

## CONCLUSION

The objective of the present study was to explore the causes of delay in construction projects. Factors related to the contractor, client/owner, consultant, material, equipment, labor and general environment factors on delay in constructions projects have been measured. Data on the study variables has been collected through structured questionnaire from thirty Construction Company located in India. Participants were approached personally to collect the data. Various statistical tools such as cronbach's alpha test, factor analysis, coefficient of variance,computation of means and standard deviations. The objective of the study is to explore the possible causes of delay in construction industry located in India which is achieved successfully. The results of the study reveal that the factors related to contractors, client, consultant, material and equipment have significant impact on delay in construction projects. However, labor related and general factors do not explain significant variance in project delay. Moreover, the study provides following recommendation for construction firms in order to overcome delay in construction projects.

## REFERENCES

*1. El-Razek, M.E.A., H. Bassioni and A. Mobarak, 2008. Causes of delay in building construction projects in Egypt. Journal of Construction Engineering and Management, 134(11): 831-841.*

*2. Shaikh, A.W., M.R. Muree and A.S. Soomro, 2010. Identification of Critical Delay Factors in Construction. Sindh University Resource Journal, 42(2): 11-14.*

*3. Assaf, S.A. and S. Al-Hejji, 2006. Causes of delay in large construction projects. International Journal of Project Management, 24(4): 349-357.*

*4. Zack Jr, J.G., 1993. "Claimsmanship": Current Perspective. Journal of Construction Engineering and Management, 119(3): 480-497.*

*5. Sambasivan, M. and Y.W. Soon, 2007. Causes and effects of delays in Malaysian construction industry. International Journal of Project Management, 25(5): 517-526.*

*6. Kaliba, C., M. Muya and K. Mumba, 2009. Cost escalation and schedule delays in road construction projects in Zambia. International Journal of Project Management, 27(5): 522-531.*

*7. R osazuwad, M., The factors and effect of delay in government construction project (case study in Kuantan). 2010, Universiti Malaysia Pahang.*

*8. Haseeb, M., A. Bibi and W. Rabbani, 2011. Problems of Projects and Effects of Delays in the Construction Industry of pakistan. Australian Journal of Business and Management Research, 1(5): 41-50.*

*9. Sweis, G., et al., 2008. Delays in construction projects: The case of Jordan. International Journal of Project Management, 26(6): 665-674.*

*10. Frimpong, Y. and J. Oluwoye, 2003. Significant factors causing delay and cost overruns in construction of groundwater projects in Ghana. Journal of Construction Research, 4(02): 175-187.*

*11. Sanders, D. and W.D. Eagles, 2001. Delay, disruption and acceleration claims. Borden Lander Gervais LLP,.*

*12. Ahmed, S.M., et al., 2003.Delays in construction: a brief study of the Florida construction industry. in Proceedings of the 39th Annual ASC Conference.*

*13. Alaghbari, W., M.R.A. Kadir and A. Salim, 2007. The significant factors causing delay of building construction projects in Malaysia. Engineering, Construction and Architectural Management, 14(2): 192-206.*

*14. Mezher, T.T.W., 1998. Causes of delays in the construction industry in Lebanon. Eng Constr Arch Manage.*

*15. Abdul-Rahman, H., et al., 2006. Delay mitigation in the Malaysian construction industry. Journal of Construction Engineering and Management, 132(2): 125-133.*

*16. Williams, T. 2003. Assessing extension of time delays on major projects. International Journal of Project Management, 21(1): 19-26.*

*17. Al-Hazmi, M.H., 1987. Causes of delay in large building construction projects. Unpublished MS Thesis, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia,*

*18. Al-Khalil, M.I. and M.A. Al-Ghafly, 1999. Important causes of delay in public utility projects in Saudi Arabia. Construction Management & Economics, 17(5): 647-655.*

*19. Al-Sedairy, S.T., 2001. A change management model for Saudi construction industry. International Journal of Project Management, 19(3): 161-169.*

*20. Al-Subaie, O., 1987. Construction Claims in Residential Houses in Saudi Arabia. Master's Thesis, Kind Fahd University of Petroleum and Minerals, Saudi Arabia,*
*21. Al-Kharashi, A. and M. Skitmore, 2009. Causes of delays in Saudi Arabian public sector construction projects. Construction Management and Economics, 27(1): 3-23*