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A STUDY ON QUANTIFICATION OF DELAY FACTORS IN CONSTRUCTION INDUSTRY (KERALA REGION)

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Abstract: - *Any project is said to be successful when it is completed in desired time and cost. The Construction industry of India is an important indicator of the development, as it creates investment opportunities across various related sectors. Construction delays can be minimized only when the causes are identified. Time is one of the major considerations throughout project management life cycle and can be regarded as one of the most important parameters of a project and the driving force of project success. This research work attempts to identify, investigate, and rank factors perceived to affect delays in the construction projects with respect to their relative importance so as to proffer possible ways of coping with this phenomenon. The construction industry is the tool through which a society achieves its goal of urban and rural development. It is one of the sectors that provides important ingredient for the development of an economy. It was through the analysis carried out, top 10 major causes of construction delays in construction industry are Shortage of construction materials, Effect of subsurface conditions and natural disaster, Delay in material delivery, Low productivity of labors, Rework due to errors, Late procurement of materials, Unqualified workforce, Low productivity and efficiency of equipment, Delay in quality control, Poor site management and supervision, Poor communication between parties & Lack of high technology.*

Key-Words: *-Leave one blank line after the Abstract and write your Key-Words (6 - 10 words)*

1. INTRODUCTION

Today, India is the second fastest growing economy in the world. The Indian construction industry is an integral part of the economy and a conduit for a substantial part of its development investment, is poised for growth on account of industrialization, urbanization, economic development and people's rising expectations for improved quality of living. Delays are one of the biggest problems in construction firm's face. Delay can lead to many negative effects such as lawsuits between owners and contractors, increased costs, loss of productivity and revenue, and contract termination.Delay could be defined as the time over run either beyond completion date specified in a contract or beyond the date that the parties agree upon for delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects.

Large scale development activities are taking place in Indian construction industry and it has assumed the proportion and responsibilities of a big business and is closely associated with nation's economy. A large number of building projects and new infrastructures are being built on a great scale which contributes to the economic growth of country. Apart from the economy aspect, the speed with which construction is carried out is also an important factor. Like other countries, India is also facing a serious issue of time and cost overruns in construction projects. The unfortunate part is that very few projects get delivered in time and on cost. Time and cost overruns have become the hallmark of construction projects in India. However, the magnitude and causes behind these time and cost overruns remain understudied.

Delays in construction can cause a number of changes in a project such as late completion, lost productivity, acceleration, increased costs, and contract termination. The party experiencing damages and the parties responsible for them in order to recover time and cost. Throughout the world, the business environment within which construction organizations operate continues to change rapidly. Organizations failing to adapt and respond to the complexity of the new environment tend to experience survival problems. A number of studies have been conducted to examine factors impacting on project performance in developing countries. The

construction industry is complex in its nature because it comprises large numbers of parties as owners (clients), contractors, consultants, stakeholders, and regulators. Despite this complexity, the industry plays a major role in the development and achievement of society's goals. It is one of the largest industries and contributes to about 10% of the gross national product (GNP) in industrialized countries. Delays can generally be classified into the following types.There are four basic ways to categorize type of delays

1.2 TYPES OF DELAYS

A. Critical or noncritical

B. Excusable or non-excusable

C. Compensable or non-compensable

D. Concurrent or non-concurrent

In the process of determining the effect of a delay on the project, the analyst must determine whether the delay is critical or noncritical. The analyst must also assess if delay are concurrent. All delays that are identified in the analysis will be either excusable or non-excusable. Delay can be further categorized into compensable or non-compensable delays.

1.3 OBJECTIVES OF STUDY

Construction is a dynamic, competitive, ever changing and challenging industry. This research was aimed at identifying the major causes of delay. To achieve the aims, objectives have been identified as following:

- To identify the main reasons of construction delay.
- To identify the effect and rank the factors according to their significance.
- To recommend methods of minimizing Construction delays.

2. LITERATURE REVIEW

Our project is a substantial and lengthy piece of professional work that must satisfy a number of academic requirements. The literature review is one of these important academic requirements. The literature review is a critical discussion and summary of statistical literature that is of 'general' and 'specialized' relevance to the particular area and topic of the research problem in statistics. Every statement in a literature review must be supported either by a reference to published statistical literature. In literature search we will discover what statistical knowledge exists related to our research topic, increase your statistical knowledge in your research area, find gaps (and possibly errors) in published research, generate new original ideas, avoid duplicating results of other statisticians, justify the relevance of your proposed research

2.2 REVIEW OF LITERATURE

Shujaa Safdar Gardezi et al., (2013) in his work says that the key controlling features of time, cost, quality and safety for a project are adversely affected by the impacts of such delays. This study investigates the factors contributing in time extensions in construction project according to key participants of the projects i.e. contractors, consultants and the clients. The study revealed that domestic issues of the country are the major factors resulting in the delayed completion of the projects.

Qais Kadhim Jahanger et al., (2013) aimed to identify causes of delay in construction projects in Baghdad city, and specify the most important causes of delay in the construction project through a field survey. The results show that 60 engineers responded, agree together that the most important cause of delay is (Mistakes and discrepancies in design documents) by relative importance index (RII) of 83.05%, followed by (Ineffective planning and scheduling of project by contractor).

AswiniArun Salunkhe et al., (2014) highlighted the types of construction delays and concluded that project suffers time and cost overrun.. This paper studies projects from 17 various central sectors costing above 1000crores which was ongoing and completed in the year 2012. It was found that construction delays not only lead to time overrun but to cost overrun also.

Desai Megha et al., (2013) in her study, worked on identification of causes of delays in residential construction projects. Literature reviews and structured interviews were carried out on construction projects in central Gujarat region59 causes under 9 major groups were identified. These causes were analyzed and ranked based on degree of severity and frequency .This study helped stakeholders to act on critical causes and try to reduce their effects.

Alnuaimi et al., (2013) in his field study conducted on various construction projects in Muscat area- identify various delay factors. Collected data was classified into 2 groups of projects-(2007-2008) & (2009-2010). 40% of both groups experienced delay in completion.

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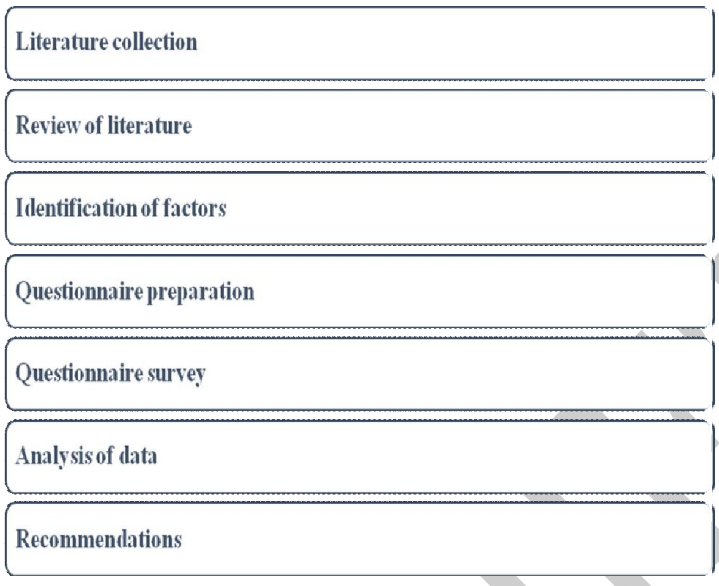
Secondly the causes of delays were changing in a pattern depending upon different variables. Owner related problems were found to be the dominant and first to seek solution.

Kaming et al.,(1997) carried out a research to study the impact factors on 31 high-rise projects in Indonesia and it was found that time overrun is less severe than cost overruns. The significant factors that lead to cost overrun are material fluctuation, inaccurate material estimation and degree of complexity.

3. RESEARCH METHODOLOGY

The methodology for this project proceeds as follows:-



The research conducted in this study is mostly exploratory in nature. Both primary and secondary data are used in this research, and data has been obtained through two primary avenues – desk research and questionnaire.

3.2 CRITICAL FACTORS OF INTEREST

Firstly, from in-depth literature studies, thirty causes of delay were identified, grouped into nine heads namely project itself, client, contractor, consultant, designer, materials, equipments, labor and external factors. The list of causes of delays categorized into nine groups are tabulated below:

NO:	CAUSES OF DELAYS	GROUP
1	Original contract duration is too short	Project
2	Legal disputes b/w various parties	Project
3	Delay in progress payments by owner	Client
4	Delay in approving shop drawings and sample materials	Client
5	Poor communication and coordination by owner and other parties	Client
6	Difficulties in financing project by contractor	Contractor
7	Conflicts in sub-contractors schedule in execution of project Contractor	Contractor
8	Rework due to errors during construction	Contractor
9	Poor site management and supervision by contractor	Contractor
10	Poor communication and coordination by contractor with other parties	Contractor
11	Ineffective planning and scheduling of project by contractor	Contractor

12	Poor qualification of the contractor's technical staff	Contractor
13	Delay in performing inspection and testing by consultant	Consultant
14	Late in reviewing and approving design documents by consultant	Consultant
15	Inadequate experience of consultant	Consultant
16	Mistakes and discrepancies in design documents	Designer
17	Delays in producing design documents	Designer
18	Shortage of construction materials in market	Materials
19	Delay in material delivery	Materials
20	Late procurement of materials	Materials
21	Shortage of equipments	Equipment
22	Low productivity and efficiency of equipment	Equipment
23	Lack of high technology mechanical equipment	Equipment
24	Shortage of labours	Labours
25	Unqualified workforce	Labours
26	Low productivity level of labours	Labours
27	Corruption	External
28	Effects of subsurface conditions and natural disasters	External
29	Unavailability of utilities in site	External
30	Change in Government regulations and laws	External

Table 3.1:- Factors affecting construction process under 9 different heads

3.3. QUESTIONNAIRE PREPARATION

A questionnaire was designed based on the objectives of the study, which are causes of construction delays. A questionnaire survey was developed to get the opinion and understanding from the experienced respondents regarding to the construction delays problem. The questionnaires are all classified into 2 sections:

- **SECTION A**: Company and respondent profile
- **SECTION B**: Construction delay factors

Based on the literatures and factors considered, a Questionnaire was designed as a measurement tool for delay in construction. The above mentioned sixty factors were adapted to measure delay in construction project. Also the respondents were asked to rate their level of argument according to 5 point scale(Likerts scale).The questionnaire that is prepared is being attached in Appendix I of this report.

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4. DATA ANALYSIS METHOD

The relative importance index method to determine the relative importance of the variouscauses and effects of delays. The same method was adopted in this study within various groups (i.e. clients, consultants or contractors). The four-point scale ranged from 1 (not important) to 5 (extremely important) was adopted and transformed to relative importance indices (RII) for eachfactor as follows:

RII = ∑ W / A * N

where W is the weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (i.e. 5 in this case), and N is the total number of respondents. The RII value had a range from 0 to 1 (0 not inclusive), higher the value of RII, more important was the cause or effect of delays. The RII was used to rank (R) the different causes. These rankings made it possible to cross-compare the importance of the factors as perceived by the three groups of respondents (i.e. clients, consultants and contractors). Each individual cause's RII perceived by all respondents were used to assess the general and overall rankings in order to give an overall picture of the causes of construction delays. These rankings made it possible to cross compare the relative importance of the items as perceived by the three groups of respondents. The relative importance index, RII, was computed for each cause to identify the most significant causes. The causes were ranked based on RII values. From the ranking assigned to each cause of delays, we were able to identify the most important factors or causes of delays.

4.2 RELATIVE IMPORTANCE INDEX METHOD

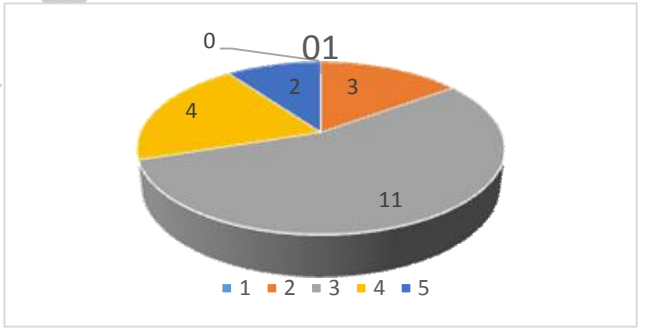
Though the term importance often has numerous connotations, sometimes referring to statistical significance while at other times referring to practical significance, our use of the term relative importance refers to the contribution a variable makes to the prediction of a criterion variable by itself and in combination with other predictor variables.Relative importance weights are a useful supplement to multiple regression because they provide information not readily available from the indices typically produced from a multiple regression analysis. When one is mainly concerned with how much scores on the criterion variable would change based on a unit increase in a predictor while holding the other predictors constant, then regression coefficients are well suited to address such a questionthe strength of relative importance weights is that they help us better understand how various predictors combine in a multiple regression equation. The ability to correctly partition predicted variance to the appropriate variables can only aid in the development of more sound theories.

5. DATA INTERPRETATION AND ANALYSIS

Here we consider 30 factors under different heads that causes delay in construction industry. A questionnaire including these factors were send to 30 different companies among which 20 replied, 6 were rejected because of non- completion in response and four were not responded. A general analysis of top 5 factors and their responses is given below in a pie-chart format:

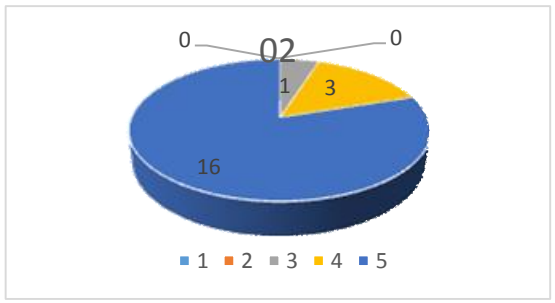
1. REWORK DUE TO ERRORS

Rework occurrences adversely affect the project performance aspects eg:- with respect to cost, time, stakeholders satisfaction. To some extent rework in construction projects also depends on external conditions such as excessive workload and market conditions. From fig 5.1, 2 respondents says that rework is most important factor that causes delay in construction & 3 of them says that it's not important.



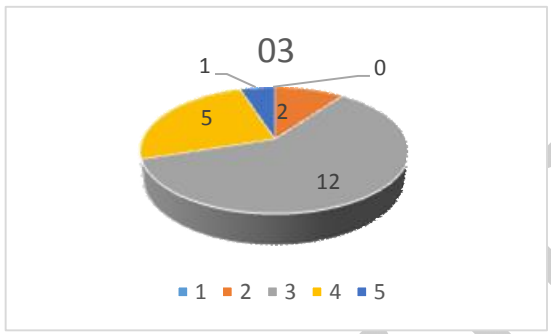
2. SHORTAGE OF CONSTRUCTION MATERIALS IN MARKET

Shortages in basic materials like sand, cement, stones,bricks, and iron can cause major delays in projects. This will make the construction process to have a slow progress. According to the analysis this was proved to be the major factor that causes delay in construction projects. About 19 of them rated it as important according to fig 5.2.



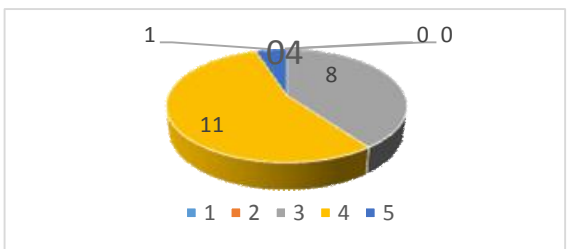
3. LATE PROCUREMENT OF MATERIALS

Sufficient materials should be in stock at the site or else the late procurement will not allow the project to be executed in the planned order. Decisions about material procurement may also be required during the initial planning and scheduling stages. Approximately 17 of them rated it as an important factor that causes delay in construction from fig 5.3.



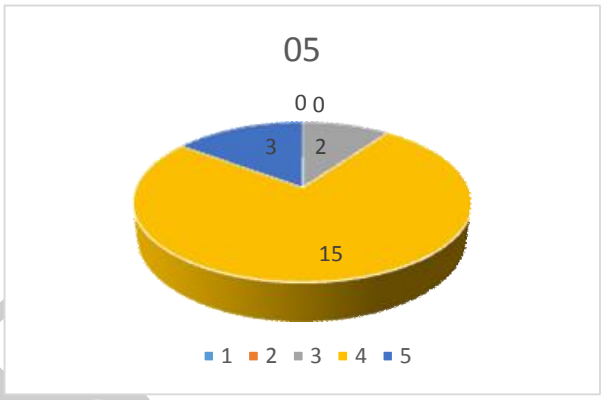
4. LOW PRODUTIVITY LEVEL OF LABOURS

Labor productivity is associated with units of product per labor hour. If this is comparatively low for a particular construction process then this will face sufficient delay and increase in total cost in its path. Age, skill, experience and motivation will determine the labor productivity at a site. Here from fig 5.4, 12 of them consider it as very important and 8 of them as important factor causing delays.



E FFECT OF SUBSURFACE CONDITION AND NATURAL DISASTER

Differing site conditions in construction projects can cause schedule delays, cost increases, and dangerous working conditions, or invalidate design assumptions. Construction projects necessarily involve the assessment of site surface (and subsurface) conditions to select the best means and methods to develop a construction schedule and bid and to complete the project. About 18 of the respondents rated it as an important factor that causes negative impact in construction process from fig 5.5.



5. RESULT AND CONCLUSION

Delays occur in every construction project and the magnitude of these delays varies considerably from project to project. Realizing the importance of subject, construction delay not only results in time overrun but also in cost overrun. There are various causes due to which project suffers from these delays. As the project is running on many number of factors & participant, these all are having individual causes. But the important participants like owner, contractor, and consultant have more influence on project performance. Hence the causes of these participants are discussed which will helpful to improve the project delivery in terms of time as well as cost efficient. 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 delay in order to minimize and avoid the delays in any construction project.

6.2 RESULT

Construction delay in construction industry is explained through literature review and field survey. Through in-depth literature review 30 causes of delay were identified, the factors combined into nine groups. About 20 construction firms including contractors, designers and consultants responded the questionnaire forms. A summarized form of the questions and responds are given in the following table. From this table we can also infer what each respondent have given to each question.

6.3 CONCLUSION

The objective of this research was to identify the main causes of delay in construction project. A literature review was conducted to identify the causes of delay stipulated in the literature. From the literature review, the various factors influencing construction delay were identified.

The relative importance index was used to rank the effect of each cause of delay. With this method shortage of construction materials was ranked 1. Among 20 respondents, 16 rated it as most important cause of delay, 3 rated it as very important and only one rated it as important. Itwas found that top 10 major causes of construction delays in construction industry are Shortage of construction materials, Effect of subsurface conditions and natural disaster, Delay in material delivery, Low productivity of labors, Rework due to errors, Late procurement of materials, Unqualified workforce, Low productivity and efficiency of equipment, Delay in quality control, Poor site management and supervision, Poor communication between parties & Lack of high technology.

6.4RECOMMENDATIONS

According to the findings during analysis , following points can be recommended in order to minimize and control delays in residential construction projects.

1. **For shortage of construction materials**-owner or contractor should take care of that they are having sufficient material with them with help of material management such as EOQ so that they will not suffer from lacking of materials and also dead stock will not exhausted from the stores.
2. **For unskilled, inexperienced labours**-quality and experience of labour supply can have major impact on the projects. in case of shortage of labours, for small works they can use the small equipments to replace some manpower so that instead of doing work manually machine can do the work faster. Owner or contractor should take care of that they should have sufficient labours with them to complete the work well before . The staff will be more effective if there are enough numbers of engineers,planning managers,technicians, and foremen, so the responsibilities would be shared between all of them.
3. **For rework due to changes and errors in project**-it can be avoided from the initial stages of the project ,if planning is accurate there is no need of rework to be done errors also can be avoided if details in drawings are given accurately.
4. **Performing inspection and testing by consultant**-is an important activity during construction since lower inspection may result in lower quality of work.
5. **For inaccurate site management**-in case of inaccurate site execution rework and corrections has to be done. And it will take additional time. Hence contractor or site supervisor should not do any mistakes when actual work has been started. Planning of building and designing should be implemented accurately. As the project management is important part, well experienced project manager should be appointed on site so that he will manage all the activities on site.
6. **For delay in obtaining permits from authorities**-the owner should do accurate time planning such as he should do all the necessary formalities well before the commencement for that he should approach to architect, engineer for planning and designing so that all the necessary documents and drawings can be submitted to the authorities in time and they will not affect the project delivery time.
7. **For mistakes and delays in producing design documents**-in case of unrealistic and complicated drawings given by architects it may difficult for RCC designer to fit that design technically in that case changes are suggested by the RCC designer that will cause delay and rework must be done. For this faster completion of work must be done by different parties. Proper and timely communication must be done to avoid delay.
8. **For unclear and inadequate details in drawings**-at the time of submission of drawings architect, engineer should give all the necessary details without any omissions. Drawings should be very much clear an easy to understand so that at the time of actual execution of work one will not face any difficulty and wastage of time and project will complete in time as per originally planned.
9. **For poor communication and coordination**-since there are many parties involved in a project such as client, consultant, contractor, sub-contractors, communication and coordination with other parties is a very crucial factor to achieve the project to finish on time. Effective communication can alleviate most of the delay factors. Proper communication and coordination channels between the various parties should be establish during each phase of construction .
10. **For subsurface conditions**- Construction projects necessarily involve the assessment of site surface (and subsurface) conditions to select the best means

and methods to develop a construction schedule and bid and to complete the project.

11. **For Corruption-** constitutes a serious threat to Construction Industry improvement as it has significant effects on construction delays. There is an urgent need for developing a legal framework for fighting corruption, whereas the current framework has been outdated and unclear.
12. **Security** issues have prevented some projects from being completed on schedule. Poor security is the most difficult challenges that stakeholders face in implementing construction projects.
13. **For experience of design team-** the project design such as planning, RCC design, plumbing, electricity etc should be designed by experienced people. So that design will complete faster within minimum correction, which is ultimately beneficial at the time of execution of work.
14. Contractor should manage his financial resources in order to not face money problems and plan a cash flow by utilizing progress payments. Pay progress payments to the contractor on time because it impairs the contractor ability to finance the work and also motivate him to continue working in high rate.

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