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Identification of influencing factors causing Delays in Construction project by Factor Analysis

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Abstract – *Construction industry in India is mounting with very rapid speed. In India, construction is one of the largest economic activities after agriculture. One of the most noteworthy problems that may occur in the construction project is delays and the consequential of these delays differs considerably from project to project. Any disturbances to the project objectives will certainly donate to project delays with its specified opposing effects on project aims. Delays on construction projects are becoming a worldwide phenomenon. The objective of this study was to identify the reasons for delay in construction buildings. These factors were identified from literature review and using these factors questionnaire was prepared and it consists of total of 40 factors causing delay. The questionnaire form was directly given to various construction companies in personal. The data were analyzed using reliability statistics, factor analysis, correlation and regression. From this analysis, key dimensions causing delay in construction can be found.*

Keywords: *Contractor, Owner, Labor, Design, Material, External*

1. INTRODUCTION

Construction delay is measured to be one of the recurring problems in the construction industry and it has a conflicting effect on project achievement in terms of time, cost and quality. Leading to achievement is highly critical factor in project life cycle. Also due to huge struggle in construction industry it is crucial to study the causes and critical factors which control the project success.
Construction delays can be defined as the slow achievement of work compared to the planned schedule or contract schedule. Construction delays can be lessening only when their causes are identified.
The project delay in the construction industry is a worldwide or large-scale detectable fact affecting not only the construction industry but the overall economy of a country as well. Project delay involves multiple complicated issues all of which are perpetually of decisive magnitude to the parties to the construction contract.

Delay factors are considered to be compelling factor in the delivery of a construction project on time, within budget and at the required quality. The success of the construction project requires strong strategies, good practices and careful judgment for completion of project on schedule with proper quality and with estimates cost. Delays are the most familiar and costly problem encountered on construction projects. Construction delays are significant part of the construction project life cycle. Even with present advanced technology, and management understanding of project management techniques, construction delay projects continue to suffer on delays and project completion dates. The major reason for delay includes strikes, rework, deficit organization, shortage of materials, machinery failure, and change orders. Delays are costly to all parties involving in the construction industry and often result in dispute. The time and expense incurred to produce a claims document in itself is consequential. There is room for improvement in present practices for keeping track of delays. Therefore, following an exile and more accurate delay analysis technique can be used to reduce the delay in construction.

2. SCOPE OF WORK

The scope of the study will shelter the construction projects of residential and commercial buildings. This study is adorable to evaluate the level of understanding and smearing these delay concepts in planning, design and field operation. The questionnaire would be planned based on the causes of construction delays and it will be dispersed to the site engineers, project managers, supervisors and others.

3. LITERATURE REVIEW

The following are the outline of literatures collected from past research and studies. The most evident of them are relevant to the current study are being reviewed.

Adnan Enshassi et al (2016) appraise the factors leading to time and cost overruns in construction projects, Gaza Strip. The survey included 110 delay factors, 42 cost overrun factors. This study concluded that the major factors which are made delay the construction process could be removed by better management practices.

Remon F. Aziz et al (2016) lists the construction delay factors. The questionnaire was prepared and dispersed to 500 construction from the identified 293 delay factors Relative Importance Index (RII). The most contributing factors and groups to delays were identified, and some further suggestions were proposed.

Majed Alzara et al (2016) identifies the major factors of project delays in northern Saudi Arabia The delay factors were collected from the University Projects Director were then compared to Saudi construction projects. It accord a solution to minimize delay factors and develops its performance using Performance Information Procurement System.

Samer Alsharif and Aslihan Karatas (2016) scrutinize a outline for identifying causal factors of delay for operable nuclear power plants schemes.

Greeshma b Suresh and Dr.S.Kanchana (2015) had done a study on assesment of delay factors in construction industry in Kerala region. Top 10 major factors of construction delays in construction industry are identified.

Prakash Rao and Joseph Camron Culas (2015) delivers the major factors of construction delays, the effects of delays, and methods of reducing construction delays. Site management and supervision, effective strategic planning, and clear information and communication channel are the methods to reducing delays.

Michal Gluzak and Agnieszka Lesniak (2015) compiles the findings of a survey anticipated at classifying the most important factors of delays in construction works from the client's perspective. A factor analysis was allowing to understand the dependencies among them.

K.L.Ravisankar et al (2014) conducted a study on the assessment of delay factors in construction industry. The questionnaire is formed which have totally 50 delay factors and is sent to different construction companies by email and in by personal.

Pablo Gonzalez et al (2014) suggest to overcome this limitation, this paper outlines delay causes in activities that were not completed as scheduled. It contributes to a methodology to examine the quantitative dimensions of the delay issue. The paper proposes two indicators which includes reason for noncompliance and delay index (DI) as a time-performance indicator that describes the impacts of delay on critical and noncritical activities.

Mohamed M. Marzouk et al presents a list of construction delay causes. The feedback was obtained through interviews. The Frequency Index, Severity Index, and Importance Index are calculated. Statistical analysis is carried to test delay causes, obtained from the survey. The test results found good correlation between groups while there is significant difference between them for some delay causes and finally roadmap for prioritizing delay causes groups is presented.

4. OBJECTIVES

This study is confined with the following objectives:

1. To identify the different dimensions in construction delay.
2. To evaluate the construction delay dimensions on client dissatisfaction.

5. RESEARCH METHODOLOGY

5.1 Scope

The scope of the study is confined with the engineer's, supervisor's views on construction delay factors in Coimbatore, Tiruppur and Erode districts.

5.2 Period of study

The period of study is conducted for the period of September 2016 to March 2017.

5.3 Data collection methods

Primary data collection was completed through direct interview with experts. The first parts of the data collection have demographic profile of the respondent. The second parts of the data collection have the factors which are relating to the causes delay in construction site.

5.4 Research Gap

Though lot of studies has been conducted with regard to study on key functions of construction delay, most of the studies have been conducted in western perspective. Only few studies have been conducted in Indian context. Therefore the researcher has liked to fill the gap by way of studying the engineer's, supervisor's views on construction delays.

5.5 Descriptive statistics

The analytical profile in the data collection quoted the experience level of the respondent, their salary level, their level of designation in the field they are working in. The total survey was conducted in 110 respondents who were exported in various fields in construction project. The experts like Engineers, Contractors, Architects, Owner and Site Engineers were involved.

6. DATA ANALYSIS

Data analysis was begun in two steps. In the first stage, the dimensions/factors were retrieved using exploratory factor analysis by principal component method of analysis with varimax rotation. An orthogonal rotation was choosing for the sake of simplicity. Attributes and factors were neglected from the data set to achieve uni-dimensionality. Factors/dimensions with eigen values > 1 were taken for further analysis. Reliability tests were then executed on each retrived factor of the multi- dimensional scale.

6.1 Exploratory factor analysis

The data were found adaptable for factor analysis based on 10/10 measure of sampling adequacy 0.85 and Bartletts test of sphericity since $\chi 2$ value was 5,742.3 ($p = 0.000$). An exploratory (principal component way of extraction and varimax method of rotation) factor quantification directed on the data collected on the 40 items resulted in a six-factor solution. Six components were selected for further analysis as they had eigenvalues > 1.0 with cumulative variance explained equal to 82 percent.

Table -1: Adequacy confirmation

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.85
Bartlett's Test of Sphericity	Approx. Chi-Square	5742.3
	Df	368
	Sig.	0.000

6.2 Antecedents of delay in construction industries

Table -2: Total variance explained

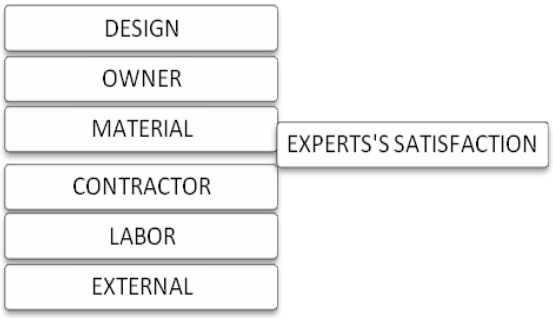
Factors	variable	Initial Eigen Values	Variance Explained	Percent of variance	Cumulative Percent						
Design	10	6.165	22.017	10.223	10.223						
Owner	10	2.070	7.393	9.463	19.686						
Material	6	1.571	5.612	6.764	35.630						
Contractor	4	1.214	4.336	5.936	48.161						
Labor	4	1.524	5.443	6.594	42.225						
External	6	1.652	5.902	9.180	28.866						

At first, all the 40 variables were used. After neglecting those items that have inadequate loadings, so we reduced to Six factors. The identified factors explain percent of total variance. The factors are named as follows:

- Design related factors
- Owner related factors
- Material related factors
- Contractor related factors
- Labour related factors
- External related factors

6.3 Proposed research model

This study is further processed with the following research model.



6.4 Proposed hypothesis

- H○1: Design will have no significant impact on customer's satisfaction on construction delay
- H○2: Owner will have no significant impact on customer's satisfaction on construction delay
- H○3: Material will have no significant impact on customer's satisfaction on construction delay
- H○4: Contractor will have no significant impact on customer's satisfaction on construction delay
- H○5: Labor will have no significant impact on customer's satisfaction on construction delay
- H○6: External will have no significant impact on customer's satisfaction on construction delay.

6.5 Inter co-relation among the Delay constructs

Table –3 Inter co-relation among delay factors

Delay factors	D	O	M	C	L	E
Design(D)	1	.448**	.425**	.575**	.316**	.340**
Owner(O)		1	.458**	.388**	.265**	.413**
Material(M)			1	.400**	.357**	.316**
Contractor(C)				1	.306**	.400**
Labour(L)					1	.246**
External(E)						1

**=1% significant level

* =5% significant level

The Relationship between delay criteria dimensions among the employees is evaluated with the help of Karl Pearson correlation coefficient and its respective significance. According to the Plan related group, the compelling positive relationship is found with Design, Owner, Material, Contractor, Labour and External. According to fund related group, the compelling positive relationship is found with Design, Owner, Material, Contractor, Labour and External related group, the compelling positive relationship is identified with regulator, skill,

leadership. According to regulator related group, the compelling positive relationship is found with skill, leadership. Regarding skill related group, the compelling positive relationship is identified with leadership.

6.6 Multiple Regression analysis

Table-4 Impact of different dimensions of construction delays by multiple regression

S.no	FACTOR	Co linearity statistics		Standard Co-efficient β	t	SIG
		tolerance	VIF			
	constant				0.85	0.391
1	Contractor	0.924	1.086	0.154	2.578	0.011**
2	Design	0.942	1.082	0.107	1.773	0.076
3	Owner	0.947	1.061	0.133	-0.217	0.847
4	Labor	0.927	1.056	0.051	-0.830	0.424
5	Material	0.922	1.079	0.074	1.249	0.234
6	External	0.979	1.084	0.622	-0.993	0.324
	R square					0.573
	F statistics					16.556
	Adjusted R square					0.538
	Significant level					0.000

**Significant at 5 percent level

The fitted regression equation is,

$Y = \beta1X1 + \beta2X2 + \beta3X3 + \beta4X4 + \beta5X5 + \beta6X6 + \beta7X7 + \beta8X8 + \beta9X9$

where,

Y = mean score on constructional delay.

X1 = mean score on design factors.

X2 = mean score on machinery related factors.

X3 = mean score on human factors.

X4 =mean score on workers related factors.

X5 = mean score on practice related factors.

X6 =mean score on regulator related factors.

X7 = mean score on stock related factors.

X8 = mean score on finance related factors.

X9 = mean score on client related factors.

a – Alpha.

e – Error term

In order to justice the magnitude of effects in this study, Cohen's rules for effects sizes 2 can be used.

The results of regression analysis for the construction delay are presented in Table 7. The results for construction delay indicated that R square is equal to 0.573. This reveals that 60.628 percent of variance is explained construction delay dimensions, F statistics is 16.556 which is significant at the 5 per cent level. The results show that Design Related Factors has a positive impact on construction delay dimensions (β = 0.154, t = 2.578 P < = 0.011). This was Followed by Client Related Factors (β = 0.701, t = 11.735, P < = 0. 00). The result revealed that there is no significant impact on Machinery Related Factors, Human Related Factors, Workers Related Factors, Practice Related Factors, Stock Related Factors, Regulator Related Factors, Finance Related Factors.

Regression analysis

To identify the construction delay dimensions that make the highest impact on the customer's satisfaction, multiple regression analysis were administered with customer's satisfaction as the dependent variable and the nine dimensions of construction delay (Design related factors, Machinery related factors, Human factors, Workers related factors, Practice related factors, Regulator related factors, Stock related factors, Finance related factors, Client related factors) as the independent variables.

7. CONCLUSION

The objective of this study was to classify the significant consequence of construction delay. For this, the researchers used exploratory factor quantification. This study has found six important dimensions of delay in construction. These are: Design, Owner, Material, Contractor, Labour and External. The study also found that there is a significant relationship between the entire dimensions. This study finding would help the management in developing appropriate policy for reducing delay in construction. This study considers only limited variables in future several variables can be included to the study of delay in construction.

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