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Factors Affecting Time and Cost Overrun in Construction Projects

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Abstract: *The Construction industry is one of the fast-growing industries in India and it contributes a lot on country's economy. But the construction industry suffers from problems that affect time and cost. Successful completion of the construction project is based on many factors among all time and cost is the most crucial factors. To manage these two things then the project would be successful. The factors that influencing time and cost overruns are identified from the literature and using these factors a questionnaire is prepared and it contains 42 factors which causing delay and cost overruns and these factors are distributed to engineers, contractors, and clients. The respondents were asked to rate the listed factors on the basis of occurrence and severity of the impact. Data received from the questionnaire was analyzed by using the statistical technique. The aim of this study is to identify the most critical factors responsible for the time and cost overrun of the construction project and suggest the remedial measures to the solution.*

Key Words: *Time overruns, Cost overruns, Causes, Effects, Reliability.*

I. INTRODUCTION

Delays give rise to disturbance to work and lead to loss of productivity, late completion of the project, increased time-related costs, and third party claims and termination of the contract. Even in present modern world having sophisticated equipment, advanced software, improved project management techniques the construction project still facing delay and cost overrun. Delay is caused by so many factors and all factors are not influence on one project it differs from project to project based on location, the value of the project, etc. In the construction industry, the material and machinery cost varies year by year. Comparing the last year statistics the cost is increasing in an unusually way. Due to the increase in the price of materials and machinery cost the project cost is also increasing and due to this, there is a high chance of delaying of the project. Labor cost is also increasing rapidly and there is a shortage of skill and experience labor in our country. To improve the delay analysis technique and continuous monitoring of every activity especially critical activities in the project there is a scope of reducing delays.

The main goal in any industry is to achieve the completion of the project within time and stipulated budget and in the construction industry also it is same. The construction industry is one of the most complex, fragmented, schedule and resource-driven industry, is always facing serious problems like low productivity, low quality, delay, over cost etc. Everywhere in the world time and cost overruns have the same problem and its effects are between clients, contractors, and consultants. In developing countries like India the problems of overruns is severe and its impacts the development of the country. The main problem in the construction industry is planning and budgeting.

Major issues which this study set out to address included are (1) Identify the different factors responsible for the time and cost overruns on the construction project. (2) Know the difference in opinions between engineers, contractors, and clients. (3) Identify the causes that lead to time and cost overrun and to evaluate their relative importance. (4) Rank the factors based on the impact on delays and cost.

Adnan Enshassi et al (2016) evaluated the factors influencing the time and cost of construction projects, the Gaza Strip (2016). The survey included 110 delay factors, 42 general cost factors. This study concluded that the main factors delaying the construction process could be eliminated through improved management practices. Prakash Rao and Joseph Camron Culas (2015), provide the main factors for building delays, delay effects and methods to reduce delays in construction. Site management and supervision, effective strategic planning, and clear information and communication channels are ways to reduce delays. Pablo González et al (2014) suggest overcoming this limitation, this paper describes the causes of delay in activities that have not been completed as expected. It contributes to a methodology to examine the quantitative dimension of the delay problem. The document proposes two indicators including reasons for the failure and delay index (DI) as a performance indicator describes critical and non-critical timing impacts. Doloi H. (2012) did research to analyze the factors which affect the cost and time in Indian construction projects. He concluded that the main factors that cause the cost and time overruns are poor site conditions, low-level site management, and

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inflation. Aftab Hameed Memon et.al, (2012) the most significant cause of cost overrun included the fluctuation in prices of materials, cash flow and financial difficulties faced by contractors, delay in progress payment by owner, frequent design changes, shortage of materials, and poor financial control on site. Ram Singh (Economic and Political Weekly 2010) from this study, the main reason behind cost overrun is a delay. Bigger projects have experienced higher cost overruns when compared to smaller projects. Due to imperfect techniques and contractual incompleteness, some delays and cost overruns are inevitable. Narayan (2010) mentioned that with each scope change, precious project resources are diverted to activities that were not identified in the original project scope, leading to pressure on the project schedule and budget. Project scope change could be as a result of wrong initial scope definition, inherent risk and uncertainties, sudden change of interest, project funding change, etc., this could lead to change request which in turn could lead to change in project deliverables, budget and/or even the entire project team.

Ameh, Soyingbe, & Odusami (2010) investigated 42 causes of cost overrun and found that the lack of experience of contractors, cost of material, fluctuation in the prices of materials, frequent design changes, economic stability, high interest rates charged by banks on loans and mode of financing, bonds and payments as well as fraudulent practices and kickbacks as the dominant factors causing cost overrun. Akinci & Fischer (1998) according to them even a marginal cost overburden can sweep away the profit of a job, and continuous cost overburdens in most of the projects of a firm can lead to bankruptcy. Projects can be delivered within the budget but that requires a good starting estimate, project management discipline and an awareness of factors that can cause cost escalation.

The research strategy adopted for this paper is quantitative research. Quantitative research is chosen to know stakeholders perception regarding time and cost overrun. A questionnaire survey is adopted to identify the factors causing the time and cost overruns. It is developed by the study of literature of various papers, books, discussion with the subject experts and the construction professionals. From the data given by the construction professionals identify the factors and rank according to the impact and severity on project completion time and cost.

II. DATA COLLECTION

The questionnaires were distributed to project managers, site engineers, and contractors of various construction projects. The characteristics of the respondents participated in the questionnaire survey are summarized and showed in Table I and it indicates that majority of the respondents are consultants followed by contractor and client. The respondents participated in the survey are categorized according to their designation and experience and it was shown in Table I.

Table I Respondents Demographics

Respondents work experience		
Experience(yrs)	Number of respondents	Percentage
0-5	8	15
6-10	26	50
>10	18	35
Total	52	100
Number of Respondents		
Client	12	23
Contractor	15	29
Consultant	25	48
Total	52	100

III. POST DATA ANALYSIS

The analysis of the obtained data includes the checking the reliability of data that means the obtained data is acceptable or not. It also includes that there is any significant difference between construction professionals (Clients, consultants, and contractors) on the factors causing delay and also identifies the most critical factors causes time and cost overruns by ranking the factors using relative importance index method. In this paper the top most factors were analyzed according to the view of contractor, client and consultant.

A. Reliability Analysis

Reliability can be quoted with the Stability, Consistency, or dependability of a measuring tool. The test is repeated for the same sample of people twice and then comparing the scores obtained by calculating a coefficient of reliability (Polit and Hunger, 1985).

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Reliability test is conducted in SPSS to check the stability and consistency of a data. Here to test the reliability of the collected data, Cronbach's alpha method was used. If Cronbach's alpha is <0.6, the data is not reliable and cannot be adopted and if it is >0.6, reliability is very high. The result of reliability test as shown in Table II Alpha value of all category factors greater than 0.6, which concluded that this research instrument is good and reliable. Cronbach's alpha reliability coefficient normally ranges between 0 and 1.

$$\alpha = \frac{N * \bar{C}}{\bar{V} + (N-1) * \bar{C}}$$

Where,

α = Cronbach's alpha

\bar{C} = average variance

\bar{V} = average inter-item covariance among the items

N = Number of items

Table II Cronbach's Alpha

Cronbach's alpha	Number of Items
0.636	42

The reliability of data obtained from the survey is tested by using Cronbach's alpha. The result was come as acceptable that means the data was reliable.

B. One-way ANOVA test

Analysis of variance (ANOVA) is used to test the opinions of two or more different group usually at least three groups. Often used for testing the opinions that there is any difference between the different category of persons. Here, it is in between clients, contractor, and consultant.

ANOVA - When there is only a qualitative variable denoting groups and a single measurement variable (quantitative), an ANOVA is performed. For a one-way ANOVA the observations are divided into mutually exclusive categories, giving the one-way classification.

Null Hypothesis (Ho) – There is no significant difference among construction professionals in the perception of time and cost overrun factors.

Alternate Hypothesis (H1) - There is a significant difference among construction professionals in the perception of time and cost overrun factors.

From the analysis of the data, it was concluded that there is no significant difference between the client, contractor, and consultant opinion on the factors influencing time and cost overruns.

C. Relative Importance Index Method (RII)

Kometa et al. used the Relative Importance Index method to determine the relative importance of the various causes and effects of delays and cost overruns. The same method is going to adopt in this study within various groups (i.e. clients, consultants or contractors). The six-point scale ranged from 0 (no impact) to 5 (very high impact) is adopted and transformed to relative importance indices (RII) for each factor as follows:

$$RII = \frac{\sum_{i=1}^n a_i * f_i}{N * A}$$

Where,

a_i =constant expressing the weight given to the i th response

f_i =the variable expressing the frequency of the i th response

N=Total number of respondents for a given factor

A=Highest weight given (i.e. 5 in this case)

Table III Relative importance index of the five most significant factors causing Time and cost overruns

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S.no	Factors	Relative Importance Index value
1	Shortage of labor	0.83
2	Poor site management and supervision by the contractor	0.80
3	Poor Co-ordination & Communication between Parties	0.79
4	Effects of Subsurface Conditions (eg. Soil, high water table)	0.78
5	Inaccurate estimates	0.76

D. Time and Cost Overrun related factors

- 1) *Contractors view:* Table IV shows that the contractors ranked "Difficulties in financing project by the contractor" in the first position with an RII of 0.83. This indicates how financing problem affects the project time. If there is a difficulty in financing in construction project it will lead to a significant delay in a project. Also, the contractors will not be able to purchase the needed equipment for work. The client pays advance payment before the project starts. So the financial problem is due to contractor's mismanagement. The respondents from contractors ranked "Weather condition" as the second with RII of 0.79. It is known that July and August are the rain period and most construction projects are taking this into consideration. But sometimes the rain might extend up to October or might start early in June. This will affect the project completion time significantly. Delay in sub-contractor work is ranked by the contractor as the third important factor that can cause time overrun with an RII of 0.77. Proper planning is important for accomplishing the project successfully. If the contractors fail to plan the sub-contractor work properly it will affect the project completion time and it will be a big loss for contractor and end users. The poor site management problem is ranked as the fourth important factor that can cause time overrun with an RII of 0.73. Poor management causes many constraints at the projects, such as poor following up of progress, incorrect distribution of works, un-commitment of employees at the site, poor monitoring of the project, etc. These factors above contribute to delay the project. Shortage of labor problem is ranked as the fifth important factor that can cause time overruns with an RII of 0.73. Shortage of labors causes serious problem to the work which causes too much of delay to the project.
- 2) *Consultants view:* Table IV shows that the consultants ranked "Shortage of Labour" with an RII of 0.85 as the first factor that causes delay. This indicates the high importance of labor for the progress of the project. Any shortage of labor for the contractor will cause many problems such as slow progress and work decline in productivity. This causes a change in the project schedule and continuously monitor the schedule and increase the stress in engineers for the continuously updating the schedule. The second factor that causes delay was "Inaccurate estimates" with an RII of 0.76. This directly delays the work after bill payment starts. Due to inaccurate estimates, the payment for the activity will be more or less it will lead to the disputes between contractor and consultant and finally the work goes delayed. The third important factor ranked by consultants was "Effect of sub-soil condition" with an RII of 0.74. Sub-soil condition severely affects the project duration. The project having poor sub-soil condition it will affect the project duration and ultimately it will lead to a delay of the project. A change in the sub-soil condition makes the change in the design of the structure that will lead to the extra cost compared to the budgeted cost. The consultants ranked "Low productivity levels of labor" in the fourth position with RII of 0.7, which indicates that the completion time of the activity depends on the productivity of the labor. The fifth important factor ranked by consultants was "Rework due to errors during construction" with an RII of 0.7. During construction stage rework due to errors is frequent in every construction project. Rework in the project makes a lot of cost and time overruns and makes many disputes between client, consultant, and contractor.
- 3) *Clients view:* Table IV shows that clients ranked "Rework due to errors during construction phase" as the first factor that causes a delay with an RII of 0.82. This result is in compare with the contractor and consultant opinions; the client opinion has more value. The second important factor was poor site management with an RII of 0.78. Due to the poor site management, there is a lot of wastage of material and disputes between contractor, consultant, and client.

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Table IV Factors influencing time and cost overruns from point of view of contractors, consultants, and client

Factors	Client		Contractor		Consultant	
	RII	Rank	RII	Rank	RII	Rank
Inadequate brief	0.38	37	0.48	28	0.44	35
Inadequate specification	0.55	21	0.63	13	0.6	16
Use of Standard Documentation	0.43	34	0.45	32	0.42	37
Late Consultation with planning authority	0.45	31	0.4	36	0.46	34
Inaccurate estimates	0.72	6	0.56	22	0.76	2
Difficulties in a choice of site	0.27	42	0.36	38	0.29	42
Inexperience of the Consultants	0.5	26	0.57	19	0.66	6
Changes in key personnel	0.42	35	0.4	36	0.41	39
Difficulties in financing project by contractor	0.72	6	0.83	1	0.66	6
Conflicts in subcontractors schedule in execution of the project	0.5	26	0.57	19	0.48	32
Rework due to errors during construction	0.82	1	0.64	11	0.7	5
Poor site management and supervision by the contractor	0.78	2	0.73	4	0.66	6
Ineffective planning and scheduling of project by contractor	0.47	29	0.52	26	0.52	27
Improper construction methods implemented by contractor	0.6	13	0.61	17	0.55	23
Delays in sub-contractors work	0.63	12	0.77	3	0.65	9
Frequent change of sub-contractors because of their inefficient work	0.72	6	0.63	13	0.63	10
Poor qualification of the contractors technical staff	0.6	13	0.53	24	0.54	25
Shortage of construction Materials in market	0.77	3	0.41	35	0.56	21
Changes in material types and Specifications during the construction	0.6	13	0.63	13	0.56	21
Delay in material delivery	0.6	13	0.48	28	0.59	17
Damage of sorted material While they are needed urgently	0.52	25	0.48	28	0.5	30
Late procurement of materials	0.65	11	0.64	11	0.55	23
Late in selection of finishing Materials due to availability of many types in market	0.45	31	0.53	24	0.58	18
Equipment breakdowns	0.38	37	0.35	39	0.37	41
Low productivity and Efficiency of the equipment	0.45	31	0.63	13	0.51	29
Lack of high technology Mechanical equipment	0.47	29	0.48	28	0.49	31
Lack level of equipment operations skill	0.55	21	0.44	33	0.52	27
Shortage of equipment	0.6	13	0.52	26	0.58	18
Shortage of labour	0.73	5	0.73	5	0.85	1
Unqualified work force	0.37	39	0.32	40	0.47	33

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Factors	Client		Contractor		Consultant	
	RII	Rank	RII	Rank	RII	Rank
Low productivity level of labours	0.73	4	0.65	9	0.7	4
Personal conflicts among labours	0.37	39	0.28	42	0.44	35
Effects of subsurface Conditions	0.58	19	0.56	22	0.74	3
Delay in obtaining permits from municipality	0.35	41	0.44	33	0.42	37
Weather effect on construction activities	0.6	13	0.79	2	0.53	26
Unavailability of utilities in site (such as water, electricity, telephone, etc)	0.42	35	0.32	40	0.4	40
Changes in government regulations and laws	0.57	20	0.57	19	0.57	20
Delay in performing final inspection and certificate by a third party	0.68	10	0.61	17	0.62	12
Delay of bills in case of government projects	0.5	26	0.65	9	0.62	12
Quality audits done after completion of the work	0.72	6	0.67	8	0.63	10
Extra claims by the owner at the end of the project	0.55	21	0.72	6	0.61	14
Contractual claims, such as, extension of time with cost claims	0.53	24	0.71	7	0.61	14

The third important factor was “Shortage of construction materials in market” with an RII of 0.77. This result shows the importance of planning of material procurement to complete the work in time. When the activities execution is without proper planning of material, it certainly causes the delay of the project.

The fourth factor ranked by the client was "Low productivity level of labor" with an RII of 0.73. This result is same as consultant view.

The fifth factor ranked by the client was “Shortage of labor” with an RII of 0.73. As compared with the consultant rank the client rank was low. Every year labor rates will change this causes the increase in the cost of the project. This causes more pressure on contractor and consultant to complete the project with the available human resource on the scheduled time.

IV. CONCLUSIONS

The objective of this study was to identify factors influencing time and cost overruns in a construction project. Out of 42 causes of time and cost overruns, the most common factors influencing the time and cost overrun were identified by using relative importance index method. The most common causes of time overrun are Effects of subsurface conditions, Shortage of labor, Poor coordination and Communication between Parties, Poor site management and supervision by the contractor, , Inaccurate estimates. This paper identifies key causes of time and cost overrun based on their occurrence and their impact on construction projects. In this paper, there were limitations which were encountered throughout the preparation of this research. Unavailability of adequate documented information and unwillingness in the construction firms (Clients, Consultants, and Contractors) are some of the limitations.

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