A Study of Factors Resulting in Time and Cost Overrun in Residential Construction Projects and its Remedial Measures

Amol Shinde[1], Pravin Minde[2]

[1]*P. G. Scholar, Department of Civil Engineering, TSSM's PVPIT, Pune, India*
[2]*Assistant Professor, Department of Civil Engineering, TSSM's PVPIT, Pune, India*

Abstract: **The success or failure of any project depends largely on these two factors apart from its quality. They are vital, still they are neglected. Successful management of construction projects is based on three major factors i.e. time, cost and quality. The successful completion of construction projects within the specified program has become the most valuable and challenging task for the Managers, Architects and Engineers. How to achieve this task is a problem, which should be solved. A critical analysis of time and cost over-runs of a project might help to improve the management dynamism in general and increase 'cost and time' consciousness, in particular. The overall objective of the study is to identify the factors responsible for the over-runs of time and cost in a construction project and suggest suitable remedial solutions. In the case study, we will be studying the causes responsible for overruns of a construction project and suggest the probable measures. The study analysed the different aspects of the time and cost overruns in construction projects. It is considered one of the recurring problems and has an adverse effect in terms of time, cost and quality. The causes and effects of delays in residential construction projects are identified in this paper. The causes of time and cost overrun assessed using Relative Importance Index (RII) so as to rank the factors. Questionnaire was prepared to collect the data and circulated to Client, Contractor and Consultant. Analysis of data collected is done by SPSS Statistics V24 and results, conclusion are stated in this paper.**

Keywords: Overruns, Cost and Time, Relative Importance Index (RII), SPSS Statistics

I. Introduction

Time and cost are the lifelines of any and every project. It has been observed very frequently that most of the projects in India ended with extra involvement of time, money and resources. It's a rare scene in construction industry, that a project is completed well within the estimated budget and time and with desired quality.

Successful management of construction projects is based on three major factors i.e. time, cost and quality. The successful completion of construction projects within the specified program has become the most valuable and challenging task for the Managers, Architects and Engineers. How to achieve this task is a problem, which should be solved. The subject of project cost and time over-run has presently dragged a widespread attention of project managers and the other project related personnel. An in-depth study and critical analysis of cost-time figures might be able to decide whether the outwardly appearing over-runs are really serious lapses to the extent they are felt. It might reveal the true causes behind these over-runs.

Although a lot of studies are being made and various methods are evolved to check the over-runs, yet it is experienced that most of the project are exceeding the scheduled budget and time. The reasons are many and vary from project to project. A critical analysis of time and cost over-runs of a project might help to improve the management dynamism in general and increase 'cost and time' consciousness, in particular. It might also lead to an understanding of the vivacity of the problems and thus curb the destructive tendency of irrationally arriving at a sensational conclusion on these over-runs.

II. Literature Survey

Daniel C. Okpala and Anny N. Aniekwu concerns an investigation into the causes of high costs of construction in Nigeria. A preliminary survey involving all the professionals in the construction industry identified delays and direct cost overruns of the project as the principal factors leading to the high cost of construction. A questionnaire was then designed by the author, incorporating factors causing delays and cost overruns. It was distributed to engineers, architects; quantify surveyors, contractors and others involved in construction. The most common cause identified by all three parties was 'change order'.

Fugar, F.D.K et al. (2010) have identified 32 major delays in Ghana and calculated rank of delay using Relative Importance Index (RII) and grouped in to 9 categories. The result shows that financial group factors ranked highest among the major factors causing delay in construction project. Reliability test for questionnaire was conducted by Aedwin Warghese (2015) with the pilot survey response. Cronbach's alpha (α) is the most common measure of internal consistency or reliability. The test was conducted with the help of SPSS software and α value obtained was o.99 which is 0.7 and proved questionnaire is to be reliable. Desai Megha (2013) has done data accuracy check using non parametric test by calculating Spearman's rank correlation coefficient and results shows that it imply good correlation between the rankings of two parties for the single cause of the delay.

III. Objectives

1) To increase the effectiveness of construction project by

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minimizing delays.
2) To identify the factors causing time and cost overrun in residential projects.
3) To identify the most influencing factors causing time and cost overrun in residential projects.
4) To compare the results with SPSS software.
5) To find the reliability and to check accuracy of data.
6) Suggest remedial measures to avoid time and cost overrun.

IV. METHODOLOGY

The research methodology contains a literature review and questionnaire survey. The literature review was conducted though paper published books, conference proceedings, internet and international project management journals. As the outcome of this literature review 50 causes of time and cost overrun for residential projects were identified. Present study suggests different techniques for ranking of causes of time and cost overruns. In this paper, Relative Importance Index (RII) was used to calculate each cause of time and cost overrun.

The research methodology has been divided into following stages:
1) Formulation of objective of study
   a) Collection of references includes journals, technical reports and books.
2) List out the factors causing delay
   a) To address the most contributing factors and effects of delay specifically in residential projects.
   b) All factors and effects will be identified by expert advice from professionals.
3) Preparation of questionnaire
   a) Making of questionnaire
   b) Developed questionnaire then distribute to the targeted respondent.
4) Data collection and analysis
   a) Data collection and analysis based on RII method to rank the factors.
   b) Spearman's rank correlation to test the agreement between the groups.
5) Results and discussion
   a) To identify the important factors and effects of delay in residential project.
   b) To identify the relationship between causes and effects of delay in residential projects.
   c) Methods of minimizing construction delay.

V. DATA COLLECTION

Total 37 questionnaires were distributed to different respondents in Pune. A list of stakeholders who showed their response has been presented. The responses were obtained after personal request and visit to their respective sites of offices. Though the total number of questionnaires sent and responses received were limited but the survey covered most of the known client, consultant and contractor of Pune. The respondents are top-level experienced stakeholders hence the reliability of the survey results is expected to be high. Following table shows distribution of responses.

TABLE I
QUESTIONNAIRE DISTRIBUTED AND RESPONSES RECEIVED

Respondents	Questionnaire Distributed	Responses Returned	Percentage of Responses
Client	7	7	100
Consultant	8	7	87.5
Contractor	22	20	90.90
Total	37	34	91.89

The next stage is data collection based on 50 factors of time and cost overrun based on which questionnaire was designed. The questionnaire was organized in the form of importance scale. Respondents were asked to indicate by ticking a column the relative importance of each of the causes of construction delays (1-High Influence, 2-Medium influence, 3-Low influence, 4-Can be neglected). Total 37 questionnaires were distributed to respondents in Pune. The collection of data took 8 to 10 weeks. At end of the period, 34 questionnaires were received for analysis. The response rate by respondents is 91.89%.

VI. DATA ANALYSIS AND CHECK APPROACH

The following approaches are used for data analysis:
1) Relative Importance Index (RII) Technique:

It is used to determine the relative importance of the various causes and effect of delays. The same method is going to be adopted in this particular project within various groups (i.e. Contractors, clients, and consultant). The four point scale from 1 (High Influence) to 4 (Low Influence) is being adopted and transformed to relative important indices (RII) for each factor as follows:

$$RII = \Sigma W / (A * N) \qquad (1)$$

Where, W is the weighting given to each factor by the respondent (ranging from 1 to 4)
A is the highest weight (i.e. 4 in this case).
N is the total Number of respondents.
Higher the value of RII, most important is the cause of delay.

2) Cronbach's Alpha for Reliability Statistics:

It is a measure used to assess the reliability, or internal consistency, of a set of scale or test items. In other words, the reliability of any given measurement refers to the extent to which it is a consistent measure of a concept, and Cronbach's alpha is one way of measuring the strength of that consistency. It is most commonly used when there is a multiple linkert scale/questions in a survey which forms scale in order to determine the reliability of the scale. It will generally increase as the inter-correlations among test items increase and is known as an internal consistency estimate of reliability of test scores.

Cronbach's alpha is calculated as:

$$\alpha = (k \times c) / (v + (k-1)c) \qquad (2)$$

Where, k refers to number of scale items,
c refers to average of all covariance between items,
v refers to average variance of each item. Cronbach's alpha

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is thus a function of the number of items in a test, the average covariance between pairs of items, and the variance of the total score. Alpha (α) coefficient of reliability ranges from 0 to 1. If all of the scale items are entirely independent from one another (i.e., are not correlated or share no covariance), then α = 0; and, if all of the items have high co variances, then α will approach 1 as the number of items in the scale approaches infinity. In other words, higher the value of α coefficient, the more the items have shared covariance and probably higher degree of internal consistency.

3) Spearman's rank correlation factor:

It is used to check the accuracy of collected data according to questionnaire provided. Spearman's rank correlation coefficient is a non-parametric test which is referred as distribution free test. In this research this check approach is used to show strong agreement between the parties. The value of spearman's rank correlation coefficient (rs) varies between +1 & -1, where +1 shows perfect positive relationship means agreement, whereas -1 implies perfect negative relationship (disagreement). In short value close to unity in magnitude shows good correlation, while value near to zero shows little or no correlation. It is calculated using following formula.

$$rs = 1 - [(6 \Sigma d2) / (n3 - n)] \qquad (3)$$

Where, r is the Spearman's rank correlation coefficient between two parties,

d is the difference between ranks assigned to variables to each cause and n is the number of pair of ranks.

VII. Results and Discussion

The perspectives of clients, consultant and contractor of the 32-delay factor were analysed using Relative Importance Index (RII). The results of Cronbach's alpha reliability statistics and spearman's rank correlation coefficient factor were calculated using SPSS software and shown below.

TABLE I
RELIABILITY STATISTICS

Cases	N	%
Valid	50	100.00
Excluded	0	0
Total	50	100.00

TABLE I
CRONBACH'S ALPHA

Cronbach's Alpha	No. of items
0.917	3

After comparing the results with SPSS Software, the Cronbach's Alpha value obtained is 0.917, which is well above 0.7. Thus, the questionnaire is proved reliable.

The perspectives of clients, consultants and contractors of the 50 delay factors were analysed using Relative Importance Index (RII).

Sr. No	Factors for Time and Cost Overrun	Consultant RII	Client RII	Contractor RII	Sum
13	Change in scope of work	0.39	0.46	0.44	0.43
3	Faulty designs	0.43	0.46	0.43	0.44
40	Shortage of materials	0.43	0.43	0.48	0.45
23	Lack of coordination between parties	0.43	0.57	0.43	0.48
45	Delay in decision making	0.5	0.5	0.43	0.48
1	Obtaining Permit from Municipality	0.50	0.43	0.54	0.49
6	Improper site planning	0.54	0.46	0.49	0.50
9	Legal Disputes	0.39	0.61	0.51	0.50
24	Delays in payment of work done	0.46	0.50	0.54	0.50

Fig. 1. RII results

VIII. Findings from the Study

The reasons of these overruns were mostly known and controllable. Still they are facing these problems because of the following reasons:
1) Poor project appraisal and formulation
2) Improper implementation of plans
3) No advanced action taken by any of the parties involved
4) No advance clearances from the local authorities and other agencies
5) No adequate measures were taken for the availability and proper flow of funds
6) Delays in decision making
7) Loosely framed contracts
8) Poor monitoring and control of activities
9) Insufficient use of modern technologies available
10) Inaccurate estimate of time and cost
11) Faulty design
12) Land acquisition problem
13) Poor bidding
14) Irregular flow of finance
15) Delay in payment of work done
16) Deficiencies in management
17) Delay in decision by Client/ Architect
18) Lack of coordination between different parties involved
19) Change in scope of work

IX. Recommendations to Minimize Time And Cost Overrun

1) Consultants should ensure that all design changes during the execution of the works are handled explicitly while not compromising the desired outcome of the final project.
2) Any design errors made by consultants must be immediately rectified to avoid delays in the progress of works.
3) All working drawings must be clearly drawn indicating all the dimensions and labels to scale so as to avoid ambiguity during construction.
4) Contractors should pay particular attention to the requirements of the assignment during the pre-contract and bidding period so as to go for works that they have competitive advantage.
5) Contractors should ensure that they have enough cash flow to execute the works and desist from the practice of diverting particular project funds to non-project activities to avoid being cash-strapped during the execution of the

works. Clients must ensure that their demand in design changes during the construction period should have no adverse effects on the critical activities so as to avoid causing delays.

6) All change order demands must be evaluated to assess their impact on quality of work envisaged, scope and cost, possible claims and disruption to work so as to avoid unnecessary disputes and litigation.

X. CONCLUSION

- This paper identified 50 attributes responsible for impacting performance of the projects. These attributes were then presented to construction professionals in the form of a questionnaire. The study sought the views of clients, consultants, and contractors on the relative importance of the factors that cause delays in residential projects in Pune.

- From the Study most influencing factors causing time and cost overruns are as follows:
  Shortage of materials , Obtaining permit from municipality, Irregular flow of finance, Delay in decision making, Late deliveries of materials, Legal disputes, Shortage of skilled labor, Delay in releasing payment, Poor design, Poor site management, Poor professional management.

- After comparing the results with SPSS Software, the Cronbach's Alpha value obtained is 0.917 which is well above 0.7. Thus the questionnaire is proved to be reliable.

- The Strong correlation is observed between two parties using SPSS software.

- However the better formulation and appraisal of projects, sound implementation planning, timely decision making, advance action, good coordination between different parties, deliveries of materials on time, assurance of funds resources, better contract management, penalties and incentives, good monitoring and management techniques and definitely provides some clues for the remedial steps.

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