TIME AND COST OPTIMISATION BY DEVELOPMENT OF STANDARD OPERATING PROCEDURES IN CONSTRUCTION PROJECTS

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ABSTRACT

The Indian construction industry plays integral role in economy of India. The time and cost are fundamental constraints which are needed to be considered in construction projects. It is necessary to manage these constraints in order to achieve the project success. Cost overrun and time delay are the major problems observed during construction projects so in order to identify these factors affecting time and cost, a survey is conducted with questionnaire. The respondents were asked to rate the listed causes on the basis severity of impact. Importance of each cause is calculated on impact. Relative Imporatance Index and Spearman rank order correlation analysis is used to evaluate whether consensus of opinions exists between Time and Cost. For the time and cost optimisation the mitigating measures are applied in order to develop standard operating procedures in construction projects.
Keywords; *Time, Cost, Optimisation, Construction.*

1. INTRODUCTION

The Indian construction industry plays integral role in economy of India. The construction industry is the second largest employer and contributor to economic activity after agriculture sector. With the liberalization of the Indian Economy and Globalization, there is now a competition from various concerns of the world (T.Subramani, P S Sruthi, M.Kavitha, June 2014). A many of challenges has to face by the construction industries which include design and constructability issues, land acquisition issues, adverse political changes, shortage of talent, time and cost related issues, rising material and labour costs, structural changes. Time and cost are two main factors in a construction and they are used for planning the construction project due to which there is increase in importance of time and Cost optimization in construction projects. Time and cost should be estimated before execution of any construction activity. Optimisation is the systematic effort made to improve profit margins and to get best results under situation.
The aim of construction projects is to ensure project finish on time , within budgetand achieving other project objectives. In order to achieve these aims of construction projects it involves constantly measuring progress evaluating plans and taking corrective actions when required. In construction projects numerous project control methods, such as Gantt Bar Chart, Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM), have been developed.

1.2 Problem statement

Nowadays most projects fails due to cost and time overruns, so it is necessary to develop Standard Operating Procedures for construction sites in order to achieve productivity, operational excellence and management dynamics to help optimisation of time and cost.

1.3 Objectives

- To find out factors causing cost overruns
- To find out factors causing delay in project time.
- To analyse effect of cost overrun and time delay.
- To develop standard operating procedure for taking corrective preventive and predictive measures on factors

1.4 Construction time

The construction project is subdivided in various activities. The time duration will be estimated in order to complete an activity. Time might also be measured in months, week, shifts, or even hours to complete an activity except weekend and holidays. Activity durations frequently are tied directly to the resources applied (e.g. crew size and equipment).

1.5 Construction cost

The Cost is considered to be a common parameter of resources expenditure on a project. The estimated cost for a contract to carry out the work is known as the construction cost and is composed of the direct cost of carrying out the work and the indirect cost (site overhead).

Net cost is the sum of two separate costs:

a) The Direct cost: Direct costs are those expenses which are directly chargeable and can be identified specifically according with the activities of the project. They represent the costs of the resources used by activities, such as the materials installed, labour, and subcontractors
b) The Indirect cost: Indirect costs (site overhead or on costs) are those that are not0 specifically identified but, they are being associated with a particular work item. They include site management and supervision, offices, canteen, storage sheds, cars and other transport temporary roads and services, and general labour not assigned to production.

2. DATA COLLECTION & ANALYSIS

For data collection a well-designed questionnaire is formed in order to meet field personnel and record their view. It consists of 20 different factors affecting on time and cost of construction projects. A questionnaire is circulated among 30 different experts working in construction. The respondent rated the factors affecting time and cost optimisation. Rating of occurrence is done on the scale from 1 to 6, where 1 stand for least important, 2 for low important,3 for moderate important, 4 for important, 5 for very important and 6 for extremely important.
Prior to the survey, a literature review helped to identify most of the common factors that often lead to project cost and time overruns. Many factors were initially identified from different studies. After an analysis from different literature review, 20 factors are shortlisted for the survey. These factors and their sources are outlined in Table 1.

Table 1. Factors effective on project time and cost control

1.Inflation of prices	11.Inaccurate evaluation of time or duration of project
2.Fluctuation currency/exchange rate	12.Non-performance of subcontractor and suppliers
3.Unstable government policies	13.Project fraud and correction
4.Weak regulation and control	14. Design related changes
5.Unpredictable weather conditions	15.Financing and payment of completed work
6.Dependency on Material	16.Complexity of work
7.Low skilled Manpower	17.Descripancies in contract documentation
8.Risk and uncertainty associated with project	18.Contract and specification interpretation disagreement
9.Unstable interest rate	19.Conflicts between project parties
10.Lack of proper training and experience of PM	20.Lack of appropriate software

This six-point rating scale can be converted to a Relative Importance Index (RII) for each individual factor, using the following formula, as adopted by Kumaraswany and Chan (1997, 1998),Assaf et al (1995) and Iyer and Jha (2005):
Relative importance index (RII) = $\sum w \div (H \times N)$ (1) Where w is the total weight given to each factor by the respondents, which ranges from 1 to 6 and is calculated by an addition of the various weightings given to a factor by the entire respondent, H is the highest ranking available (i.e. 6 in this case) and N is the total number of respondents that have answered the question.
Table 2 gives the RII of the factors that are considered by practitioners as affecting their ability to control time of construction projects. The factors have been assigned rank in relation to their RII. In which Design related changes is ranked 1st with RII 0.92. Inaccurate evaluation of time or duration of project ranked 2nd with RII 0.88. Non-performance of subcontractor and suppliers ranked 3rd with RII 0.86. These are the top three factors affecting time control.

Table 2. Ranking of factors inhibiting effective project time control

Time control inhibiting factors	Rank	RII
Design related changes	1	0.92
Inaccurate evaluation of time or duration of project	2	0.88
Non-performance of subcontractors and suppliers	3	0.86
Lack of proper training and experience of PM	4	0.85
Complexity of works	5	0.83
Risk and uncertainty associated with projects	6	0.83

Low skilled manpower	7	0.80
Discrepancies in contract documentation	8	0.78
Conflict between project parties	9	0.74
Financing and payment for completed works	10	0.73
Dependency on imported materials	11	0.70
Weak regulation and control	12	0.67
Contract and specification interpretation disagreement	13	0.63
Unpredictable weather conditions	14	0.59
Lack of appropriate software	15	0.54
Inflation of prices	16	0.51
Project fraud and corruption	17	0.47
Unstable government policies	18	0.47
Unstable interest rate	19	0.44
Fluctuation of currency/exchange rate	20	0.40

Table 3. shows the RII of the factors that are considered by expert which affecting project time control. In which inaccurate evaluation of time or duration of project is ranked 1st with RII 0.93. Non-performance of subcontractors and suppliers ranked 2nd with RII 0.89. Risk and uncertainty associated with projects ranked 3rd with RII 0.88. These are the top three factors affecting cost control.

Table 3. Ranking of factors inhibiting effective project cost control

Cost control inhibiting factors	Rank	RII
Inaccurate evaluation of time or duration of project	1	0.93
Non-performance of subcontractors and suppliers	2	0.89
Risk and uncertainty associated with projects	3	0.88
Design related changes	4	0.84
Lack of proper training and experience of PM	5	0.79
Low skilled manpower	6	0.77
Weak regulation and control	7	0.75
Complexity of works	8	0.74
Inflation of prices	9	0.73
Conflict between project parties	10	0.73
Discrepancies in contract documentation	11	0.70
Contract and specification interpretation disagreement	12	0.67
Financing and payment for completed	13	0.60
Dependency on imported materials	14	0.59
Unpredictable weather conditions	15	0.57
Lack of appropriate software	16	0.51
Unstable interest rate	17	0.48
Project fraud and corruption	18	0.45
Fluctuation of currency/exchange rate	19	0.45
Unstable government policies	20	0.42

It can be show that similarity between the time control rankings and the cost control rankings. To statistically ascertain this observation, an inferential statistical test was conducted on both sets of rankings using the spearman rank correlation coefficient to test the agreement or disagreement between the two rankings. The Spearman's rank correlation is a non-parametric test. The correlation coefficient varies between +1 and -1, where +1 signifies perfect positive correlation and -1 shows a perfect negative correlation or disagreement.

The formula for the Spearman rank correlation is given by the equation below:

$$rs = 1 - (6\sum di2 / (N3 - N)). \quad (2)$$

Where rs is the Spearman rank correlation coefficient, di represents the difference between ranks for each case and N is the number of subjects or pairs of ranks.

The result of Spearman rank correlation coefficient = 0.88.

3. CONCLUSION

A questionnaire survey and field survey is carried out with the construction project experts for the in-depth information. It has been used to provide useful information on issues surrounding project control in practice on construction field. Factors affecting time and cost of the construction project are analysed to reduce their effect for the cost and time optimisation. From the survey reports, top inhibiting affecting factors for cost and time optimisation are Design related

changes, Inaccurate evaluation of time or duration of project, Non-performance of subcontractors and suppliers, Lack of proper training and experience of PM Risk and uncertainty associated with projects and Complexity of works. The result of Spearman rank correlation coefficient is 0.88, which shows the strongly agreement between ranking of time and cost affecting factors. It shows that reason for causing cost overruns are normally also reason for the time delay in construction.

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