

ESTIMATION OF PERCENTAGE COST OVERRUNS OF TAMIL NADU CONSTRUCTION PROJECTS-A REGRESSION BASED MODEL

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ABSTRACT

A successful project is mainly associated with cost and time control. For the purpose of project management and control, it is not sufficient to consider only the past record of costs and revenues incurred in a project. This study focus on investigating the factors influencing Tamil Nadu large construction projects A questionnaire survey has been made amongst Government and Private Engineers to examine the various factors affecting construction cost performance. The collected Data was analyzed with statistical tools to determine the ranking of factors. The topmost twelve factors were selected and the percentage of cost overruns was calculated based on regression model. The important two parameters which influences the top most factor escalation of cost of Construction materials were forecasted for the three more subsequent years (2015,2016 and 2017) using the available data .

Keywords: Cost overruns, construction Industries, Influencing factors, Questionnaire Survey, Tamil Nadu,

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Introduction

Good project managers should focus upon the techniques to be adopted to control the cost and time overruns in the construction projects. If the accurate cost predictions is made then the project becomes successful. Several techniques have been adopted in different countries and states to reduce the impact of cost overruns in the various construction industries. The critical and a very frequent problem is cost overrun which is almost associated with nearly all construction projects.

There are several factors that affect the construction cost and various studies have been conducted to address these factors [1-20]. A study of delays and cost increase in the construction of private residential projects in Kuwait showed that the amount of time-delays and cost increases was greater when the total cost of a residential project was higher. A major factor contributing to the time-delay and cost-increase was the inadequacy of money and time allocated to the design phase. The three main causes of time-delays were, in order, the number of change orders, financial constraints and owners' lack of experience in construction. The three main causes of cost overruns on the other hand were, in order, contractor and material-related problems and, again, owners' financial constraints [Koushki et al., 2005].

In Ghana study, 26 factors that cause cost overruns in construction of ground water projects in Ghana. According to the contractors and consultants, monthly payments difficulties was the most important cost overruns factor, while owners ranked poor contractor management as the most important factor. Despite some difference in viewpoints among the three groups surveyed, there is a high degree of agreement among them with respect to their ranking of the factors. The overall ranking results indicate that the three groups felt that the major factors that can cause excessive groundwater project cost overruns in developing countries are poor contractor management, monthly payment difficulties, material procurement, poor technical performances, and escalation of materials[Frimpong et al.,2003].

Kaming et al. (1997), examined factors influencing construction delays (time overrun) and cost escalations, in Indonesian cities. They identified project cost underestimation and project complexity as the main causes of project delays and cost overruns.Chan et al. (1997), examined the principal and common causes of delays which leads to cost overrun in Hong Kong construction projects. The study identified the following factors (1) Poor site management and

supervision, (2) unforeseen ground conditions, (3) low speed of decision making by project teams, (4) client-initiated variations and (5) necessary variations of work, as major cause of delay. Akinci and Fischer (1998) attributed cost overruns in the construction phase of a project to uncontrollable risk factors. These factors must be identified and how they affect project activities must be understood.

Karla Knight and Aminah Robinson Fayek (2000) proposed method of modeling the identified factors using fuzzy membership functions, which capture the imprecision and subjectivity associated with the measurement of the cost affecting factors. He identified Impact labour productivity is a major source of cost overruns. According Flyvbjerg (2002), the under estimation of costs in construction were almost 9 out of 10 projects. For randomly selected projects, the likelihood of actual costs being larger than estimated cost is 86%. The likelihood of the actual costs for the construction projects is being lower than or equal to estimated cost is 14%. The actual cost of the projects on average is 28% higher than the estimated cost. The best example for the above case is Suez Canal which was constructed at costs three times of the estimated cost.

There are several factors that are responsible for these cost overruns. This paper attempts to identify the major factors of cost overrun in construction sector of Tamil Nadu and can serve as the way forward for future work in coping with these overruns.

Research Methodology

The following steps were involved in the research methodology

1. A vast literature survey was carried out to understand the issues of cost overruns in different states and countries.
2. A questionnaire was developed by selecting top ranked 54 factors involved in the preliminary study.
3. A structured questionnaire survey was conducted amongst Government Engineers and Private Engineers of Tamil Nadu construction projects. Questionnaire was made with kind of questions to obtain what are the factors that are affecting the cost of the construction project.
4. Then the collected Data were analyzed with SPSS, a statistical software and the factors were ranked.

5. The data of the escalation of construction materials (Which leads top among all twelve factors) from 2011 to 2014 were collected and the material cost for the forthcoming years 2015,2016 and 2017 were predicted using Microsoft Excel sheet.
6. The formula for the prediction of the percentage of cost overruns in Tamil Nadu construction industries was obtained by Regression analysis.

Questionnaire Survey

This study was conducted to identify the issues involved in cost overruns in construction projects in Tamil Nadu. In this regard certain factors were identified through the study and their importance and impacts were discussed. The factors were identified through a questionnaire survey from construction firms (Government Engineers and Private Engineers). Table 1 shows the factors affecting the construction cost. Table 2 presents the topmost influencing factors with their RII (Relative Importance Index).

Table .1.Factors affecting Construction Cost

Sl.No	Factors affecting Construction Cost
1	Complexity of project design
2	Incompetent Project team (designers and contractors)
3	Incomplete design at the time of tender
4	Lack of coordination at design phase
5	Improvements to standard drawings during construction stage
6	Incorrect planning and scheduling by contractors
7	Lack of cost planning/monitoring during pre and post contract stages
8	Lack of experience of local regulation
9	Lack of experience of project type
10	Underestimate project duration
11	Absenteeism of labour
12	Personal conflicts among labor
13	Low motivation and morale of labor
14	Works postponed due to Strike
15	Unqualified / inadequate experienced labor

16	Frequent equipment breakdowns
17	Inadequate modern equipment
18	Low efficiency of equipment
19	Shortage of equipment
20	Slow mobilization of equipment
21	Accidents during construction
22	Delay in obtaining permits from municipality
23	Natural disasters (flood, hurricane, earthquake)
24	Slow site clearance
25	Delay in providing services from utilities (such as water, electricity)
26	Change orders
27	Delay in progress payments
28	Lack of experience of owner in construction projects
29	Slowness in decision making
30	Suspension of work by owner
31	Complexity of the project
32	Legal disputes between project participants
33	Unfavorable contract clauses
34	Original contract duration is short
35	Ineffective delay penalties
36	Changes in material types and specifications during construction
37	Damage of sorted materials
38	Escalation of material prices
39	Poor quality of construction materials
40	Unreliable suppliers
41	Lack of experience of consultant in construction projects
42	Conflicts between consultant and design engineer
43	Inaccurate site investigation
44	Late in reviewing and approving design documents
45	Delay in approving major changes in the scope of work by consultant

46	Frequent change of subcontractors
47	Inadequate contractor experience
48	Inappropriate construction methods
49	Poor site management and supervision
50	Rework due to errors
51	Unreliable subcontractors
52	Obsolete technology
53	Ineffective project planning and scheduling
54	Poor communication and coordination with other parties

Table.2. Topmost Twelve factors affecting construction cost

Sl. No	Factors of cost overruns	Government Engineers		Private Engineers	
		RII	RANK	RII	RANK
1	Escalation of material prices	0.95	1	0.980	1
2	Poor quality of materials and unreliable suppliers	0.901	2	0.960	2
3	Poor site management and supervision	0.890	3	0.939	4
4	Unqualified/ inexperienced labour	0.881	4	0.941	3
5	Shortage and slow mobilization of equipment	0.864	5	0.937	5
6	Suspension of work by owner and delay in payment	0.850	6	0.932	7
7	Delay due to Natural Disasters like flood,rain	0.849	7	0.934	6
8	Incorrect planning and scheduling by contractors	0.838	8	0.930	8
9	Improvements to standard drawings during construction stage	0.821	9	0.928	9
10	Inappropriate construction methods adopted by contractor	0.812	10	0.926	10
11	Conflicts between consultant and engineers	0.800	11	0.923	12
12	Delay in obtaining permits from municipality	0.791	12	0.925	11

Based on the experience of Engineers who participated in this survey agreed with the 54 factors collected from the literature survey and among the 54 factors ,the top twelve factors were selected based on their RII.

Regression Analysis

The questionnaire forms were also distributed to ten construction projects (5 government projects and 5 private projects) for the validation purpose. Forward stepping and backward stepping were carried out using SPSS software. Forward stepping begins with most significant variables at the first step and continues adding and deleting variables until none can improve the fit. Backward stepping begins with all candidate variables then remove the least significant variable at the first step and continues until no insignificant variable remains. This Forward stepping and backward stepping technique gave the model for predicting the percentage of cost overrun depending on twelve variables. Table 2 presents the regression based model with a squared multiple $R=0.852$. This indicates that the model is able to predict 85.2% of the validity of the collected data, which is an excellent indicator of the expected performance of the model. Only one variable has been excluded from the listed twelve variables on using this technique i.e., Delay due to Natural Disasters like flood, rain.

Table.3. Regression model

S.No	Variables	Coefficient
1	Constant	0.52
2	Escalation of material prices	0.24
3	Poor quality of materials and unreliable suppliers	0.17
4	Poor site management and supervision	0.11
5	Unqualified/ inexperienced labour	0.17
6	Shortage and slow mobilization of equipment	0.15
7	Suspension of work by owner and delay in payment	0.36
8	Incorrect planning and scheduling by contractors	0.17
9	Improvements to standard drawings during construction stage	0.10
10	Inappropriate construction methods adopted by contractor	0.10
11	Conflicts between consultant and engineers	0.10
12	Delay in obtaining permits from municipality	0.10

The predicted cost overrun percentage can be obtained as follows:

% Cost overrun = 0.52 + 0.24 (Escalation of material prices) + 0.17 (Poor quality of materials and unreliable suppliers) + 0.11 (Poor site management and supervision) + 0.17 (Unqualified/

inexperienced labour) + 0.15 (Shortage and slow mobilization of equipment) + 0.36 (Suspension of work by owner and delay in payment) + 0.17 (Incorrect planning and scheduling by contractors) + 0.10 (Improvements to standard drawings during construction stage) + 0.10 (Inappropriate construction methods adopted by contractor) + 0.10 (Conflicts between consultant and engineers) + 0.10 (Delay in obtaining permits from municipality).

For any Tamil Nadu construction project, by substituting 1 and 0 for used and unused variables respectively in this given model, the percentage of cost overrun can be predicted.

Impact of Escalation of Construction Materials

Over the past few years the construction industry suffers several problems because of the escalation of construction materials. Construction cost indices have been used to measure the cost trends in the construction industry. Estimating the increase in price over the long term is almost impossible because of the many uncertainties beyond the control of all parties. The same is true of long term construction projects with multiyear schedules and start dates in the future. Despite this difficulty, the owners of large long-term projects need to come up with the estimated cost of these projects. The more prudent way to approach these problems is to calculate a range of possible costs. In the present study, it has been found from the statistical analysis, that the leading factor is the escalation of construction material prices.

The basic inputs include simple materials such as cement, sand, and reinforcement steel. This category may also include composite products such as wood (doors and windows), Aluminum (frames for glazing) and Brass (hinges and locks). The forecasting of bulk construction materials and composite construction materials for the years 2015, 2016 and 2017 along with the collected Data of the years 2011 to 2014 have been shown in Table 3 and 4.

Table.4.Escalation of construction materials

Item No	Description of item	Unit	Rate Analysis						
			2011	2012	2013	2014	2015	2016	2017
1	Cement	Bag	260	280	300	340	390	445	515
2	Reinforcement Steel	Kg	38	40	45	54	57.5	62.8	68.1
3	Structural steel	Cu ft	45	55	65	75	85	95	120
4	River sand	Cu ft	20	23	25	30	32.5	35.7	38.9
5	40 mm coarse agg	Cu ft	20	22	25	33	35.5	39.7	43.9
6	20 mm coarse agg	Cu ft	21	24	32	38	43.5	49.4	55.3
7	12 mm agg	cu ft	20	21	27	35	38.5	43.6	48.7
8	6 mm Agg	cu ft	13	13	25	30	36	42.3	48.6
9	Bricks	1 no	4.00	4.50	5.00	5.50	6	6.5	7
10	Fly ash bricks	1 no	4.5	5.50	6.00	6.50	7.25	7.9	8.55

Table.5.Escalation of composite construction materials

Item No	Description of item	Unit	Rate Analysis						
			2011	2012	2013	2014	2015	2016	2017
1	1st class Padauk wood	Cu ft	2340	2464	2450	2600	2640.7	2708.7	2776.7
2	2nd class teak	Cu ft	2600	2800	2800	3400	3600	3900	4200
3	1st class Burma Teak wood	Cu ft	3700	4000	4000	5400	5866.7	6566.7	7266.7
6	SS Butt hinges	1 no	140	140	160	180	200	220	240
7	Brass handle - 125mm size	1 no	250	250	300	350	400	450	500
8	Brass hanging type floor door stopper	1 no	185	190	210	250	276.7	306.7	336.7
9	Aluminum handle -100mm with screws	1 no	66	70	85	100	115	130	145
10	Aluminum tower bolt 250x10mm	1 no	80	86	95	100	107.7	114.7	121.7

Through forecasting technique, it was found that the cost of cement which is the major construction material from 2013-2014, 2014-2015, 2015-2016 and 2016-2017 would increase by 13%,14%,14.5% and 15% .

Conclusions

This paper investigated the causes of cost overruns of major construction projects of Tamil Nadu. The needed information was gathered through a vast literature survey and a detailed questionnaire survey. The questionnaire were distributed among the Government Engineers and Private engineers who are working in various construction projects of Tamil Nadu. Based on their experience, a total of 54 causes of cost overruns were observed. The Relative Importance Indices of all the factors were found out using SPSS software and the factors were ranked. Among the factors, the top leading twelve factors were selected. Among the top twelve factors , 11 variables were used to predict the model. The best regression model was thus created to calculate the percentage of cost overruns of construction projects. The topmost factor was taken for forecasting purpose. Escalation of construction material greatly influences the cost overrun. Therefore a rate analysis was also carried out for the construction and other important composite materials and the inflation of prices of them in the forth coming 2016, 2017 and 2017 years were also predicted with the help of Microsoft excel. The present study contributes an excellent regression model for the practitioners of Tamil Nadu construction industries.

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