

Analysis of factors influencing construction cost overruns in large construction projects of Tamilnadu

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Abstract— Construction cost is one of the most important criteria of success of project throughout the lifecycle of the project and is of high concern to those who are involved in the construction industry. In order to manage construction project successfully, various procurement strategies have been introduced. Anyhow most of the projects have not been completed within estimated budget. A cost overrun, also known as a cost increase or budget overrun, involves unexpected costs incurred in excess of budgeted amounts due to an underestimation of the actual cost during budgeting. Cost overrun should be distinguished from cost escalation, which is used to express an anticipated growth in a budgeted cost due to factors such as inflation. This study focus on investigating the influencing factors in large construction projects of Tamilnadu. Also through questionnaire survey amongst District Engineers and Contractors various factors affecting construction cost performance were examined. Data was analyzed with statistical tools to determine the ranking of factor. It is concluded that escalation of material prices, poor quality of materials and unreliable suppliers, poor site management and supervision, inexperience of labour, shortage and slow mobilization of equipment are the most severe factors affecting the Cost Overrun of the various construction projects.

Index Terms— Construction Industry, Construction Cost, Cost Overrun, Tamil Nadu.

I. INTRODUCTION

In the construction industry, the aim of project control is to ensure the projects finish on time, within budget and achieving other project objectives. This task involves constantly measuring progress of the project, evaluating better plans, and taking corrective actions whenever required. Cost is among the major considerations throughout the project management life cycle and can be regarded as one of the most important parameters of a project and the driving force of project success. In recent years, numerous studies have been done to identify influencing factors of cost overruns worldwide. Cost overrun is greatly associated with almost all projects in the construction industry. This situation prevails more severe in developing countries where these overruns sometimes exceed even 100% of the anticipated cost of the project. These factors are primarily associated with the responsibilities of Engineers and contractors for managing cost overruns in projects.

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In recent years, construction industry has recorded a fast growth rate. Cost is considered as an important factor for the success of construction projects. However, the industry is facing a lot of challenges such as the delay to complete the project, the expenditure exceeding the budget, the building defects and poor coordination of labour. The basic aim of practitioners involved in the construction industry is to achieve the completion of project within time and stipulated budget. But due to nature of construction industry, it becomes difficult to avoid the cost as well as time overruns.

Four factors were identified from the past research works of Morris et al (1990), Kaming et al (1997) and Chimwaso (2001). These are; design changes, inadequate planning, unpredictable weather conditions; and fluctuations in the cost of building materials.

A comprehensive research made on cost overruns in global construction (Flyvbjerg, 2003), it was found that 9 out of 10 projects had overrun; overruns of 50 to 100 percent were common; overrun was found in each of the 20 nations and few continents; and overrun had been constant globally.

Olawale and Sun conducted a questionnaire survey on cost study in United Kingdom in 2010 reported that many construction projects suffer cost overruns. Only 41% of respondent participating in survey experienced cost overrun less than 10% of their cost projects. This in turn shows that 59% of respondents experienced cost overrun more than 10%. Frimpong *et al.*, studied in 2003 that 75% of the projects in Ghana, exceeded the original project cost whereas only 25% were completed within the budget.

Abdullah *et al.* (2009) mentioned that 90% of large Malaysian construction project were suffered delay with significant effect of time and cost overrun since 1984. Angelo and Reina (2002) state that the problem of cost overruns is critical and needs to be studied more to alleviate this issue in the future. They also point out that cost overruns are a major problem in both developing and developed countries. The trend is more severe in developing countries where these overruns sometimes exceeds 100% of the anticipated cost of the project.

According to Ahmed et al. (2002), delays on construction projects are a universal phenomenon and road construction projects are no exception. Delays are usually accompanied by cost overruns. These have a debilitating effect on contractors and consultants in terms of growth in adversarial relationships, mistrust, litigation, arbitration, cash-flow problems, and a general feeling of trepidation towards other stakeholders.

Many more researchers [1]-[21] have carried out various studies related to cost overruns and listed out the factors that are greatly influencing cost overruns in the construction industries. It has been observed that except few of the factors, other factors differ drastically in their ranking and relative importance for different states and countries.

The purpose of this study is to critically review and identify the applicability of past studies on determining the factors causing cost overrun in current projects. This paper attempts to identify the major factors of cost overrun in construction practice of Tamil Nadu and can serve as the way forward for future work in coping with these overruns.

II. RESEARCH METHODOLOGY

The methodology of the study is as follows:

1. A thorough literature review was done and also the expert opinions from industry experts were taken, through which a number of cost overrun causes were identified in Tamil Nadu construction industry scenario. In total fifty four factors were finalized to make part of the survey questionnaire.
2. A Questionnaire form which is consisting of two parts A and B has been developed. In Part A personal Information of the respondents (for e.g. work experience, organization, annual volume of construction work) was asked. Part B was aimed to obtain information about causes of cost overrun in TamilNadu construction industry. It was asked to rate those initially identified 54 factors according to their severity level on the given scale, information regarding maximum, average and minimum cost overrun ranges experienced over large projects and average overruns over small projects were asked.
3. Thirty (30) private Engineers and Thirty (30) Government Engineers have been approached for this study.
4. Analysis has been carried out using SPSS (Statistical package for social sciences) using the assessment of feedback from questionnaire survey.
5. Some mitigating measures have been developed for the major influencing factors which can be used in assisting the project managers to have a better control on their projects.

The specific objectives include:

- To identify the variables influencing time and cost overruns in construction projects and to evaluate their relative importance.
- To examine the collective group perspectives (Government Engineers and private Engineers) points of view on the relative significance of these factors.
- To evaluate the degree of agreement/disagreement in ranking these factors.

- To suggest some recommendations for the significant factors to improve performance index of construction projects in Tamil Nadu.

III. DATA COLLECTION AND ANALYSIS

Data collection was carried out by conducting a questionnaire survey for identifying significant factors affecting construction cost performance among contractors and Engineers for accessing the significant factors of the factors. A five point likert scale of 1-5 was adopted to assess the degree of agreement of each cause where 1 represents “Strongly disagree”, 2 - disagree, 3- moderately agree, 4-agree and 5-strongly agree. A total of 60 respondents participated in the survey process. Statistical package for social sciences was used to analyze the data. Data was checked for reliability prior to ranking the factors. This four-point scale was converted to a Relative Importance Index (RII) for each individual factor,

Using the following formula, as adopted by Kumaraswamy and Chan (1997, 1998), Assaf et al (1995) and Iyer and Jha (2005):

Relative importance index

$$(RII) = \sum W \div (H \times N) \tag{1}$$

Where $\sum W$ is the total weight given to each factor by the respondents, which ranges from 1 to 5 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. 5 in this case) and N is the total number of respondents that have answered the question. Demographic characteristics of respondents are District engineers and private contractors of Thiruvannamalai, Cuddalore, Chengalpattu and Chennai. From Table 1, the total year’s experience of the respondents is 1350 with an average of 22.5.

IV. QUESTIONNAIRE DEVELOPMENT

A comprehensive literature was conducted to identify the major factors affecting construction cost. Table 1 shows the frequency of top twelve factors affecting construction cost.

Table. 1: Preliminary Ranking Factors affecting Construction Cost

Sl.No	Factors affecting Construction Cost	District Engineers		Private Engineers	
		RII	RANK	RII	RANK
1	Complexity of project design	0.785	13	0.914	15
2	Incompetent Project team (designers and contractors)	0.771	16	0.921	13
3	Incomplete design at the time of tender	0.690	33	0.844	44
4	Lack of coordination at design phase	0.775	15	0.919	14
5	Improvements to standard drawings during construction stage	0.821	9	0.928	9
6	Incorrect planning and scheduling by contractors	0.838	8	0.930	8
7	Lack of cost planning/monitoring during pre and post contract stages	0.780	14	0.910	16
8	Lack of experience of local regulation	0.664	43	0.847	43
9	Lack of experience of project type	0.690	33	0.849	42
10	Underestimate project duration	0.662	45	0.840	46
11	Absenteeism of labour	0.769	17	0.904	19
12	Personal conflicts among labor	0.661	46	0.864	36
13	Low motivation and morale of labor	0.663	44	0.851	41
14	Works postponed due to Strike	0.660	47	0.872	32
15	Unqualified / inadequate experienced labor	0.881	4	0.941	3

16	Frequent equipment breakdowns	0.685	34	0.874	31
17	Inadequate modern equipment	0.680	37	0.869	34
18	Low efficiency of equipment	0.684	35	0.871	33
19	Shortage of equipment	0.864	5	0.937	5
20	Slow mobilization of equipment	0.864	5	0.937	5
21	Accidents during construction	0.656	48	0.866	35
22	Delay in obtaining permits from municipality	0.791	12	0.925	11
23	Natural disasters (flood, hurricane, earthquake)	0.849	7	0.934	6
24	Slow site clearance	0.672	40	0.904	19
25	Delay in providing services from utilities (such as water, electricity)	0.670	41	0.864	36
26	Change orders	0.750	18	0.862	37
27	Delay in progress payments	0.850	6	0.932	7
28	Lack of experience of owner in construction projects	0.731	20	0.856	39
29	Slowness in decision making	0.682	36	0.860	38
30	Suspension of work by owner	0.85	6	0.932	7
31	Complexity of the project	0.721	23	0.853	40
32	Legal disputes between project participants	0.608	42	0.906	18
33	Unfavorable contract clauses	0.674	39	0.878	29
34	Original contract duration is short	0.654	49	0.842	45
35	Ineffective delay penalties	0.675	38	0.908	17
36	Changes in material types and specifications during construction	0.694	31	0.902	20
37	Damage of sorted materials	0.748	19	0.900	21
38	Escalation of material prices	0.95	1	0.980	1
39	Poor quality of construction materials	0.901	2	0.960	2
40	Unreliable suppliers	0.901	2	0.960	2
41	Lack of experience of consultant in construction projects	0.704	29	0.851	41
42	Conflicts between consultant and design engineer	0.800	11	0.923	12
43	Inaccurate site investigation	0.712	27	0.896	22
44	Late in reviewing and approving design documents	0.708	28	0.876	30
45	Delay in approving major changes in the scope of work by consultant	0.731	20	0.894	23
46	Frequent change of subcontractors	0.695	30	0.890	25
47	Inadequate contractor experience	0.692	32	0.869	34
48	Inappropriate construction methods	0.812	10	0.926	10
49	Poor site management and supervision	0.890	3	0.939	4
50	Rework due to errors	0.725	22	0.882	27
51	Unreliable subcontractors	0.718	25	0.842	45
52	Obsolete technology	0.720	24	0.891	24
53	Ineffective project planning and scheduling	0.729	21	0.880	28
54	Poor communication and coordination with other parties	0.715	26	0.886	26

Table. 2: Frequency of factors affecting construction cost

Sl. No	Factors of cost overruns	District 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

Table 5: Mean, SD and ranking of factors affecting construction cost

S.No	Factors of cost overruns	Mean	Std.Dev	Rank
1	Escalation of material prices	4.77	0.77	1
2	Poor quality of materials and unreliable suppliers	4.70	0.92	2
3	Poor site management and supervision	3.97	0.76	3
4	Unqualified/ inexperienced labour	3.93	0.74	4
5	Shortage and slow mobilization of equipment	3.90	0.31	5
6	Suspension of work by owner and delay in payment	3.87	0.51	6
7	Delay due to Natural Disasters like flood,rain	3.83	0.53	7
8	Incorrect planning and scheduling by contractors	3.70	0.65	8
9	Improvements to standard drawings during construction stage	3.60	1.07	9
10	Inappropriate construction methods adopted by contractor	3.30	0.70	10
11	Conflicts between consultant and engineers?	3.13	0.51	11
12	Delay in obtaining permits from municipality	3.07	0.52	12

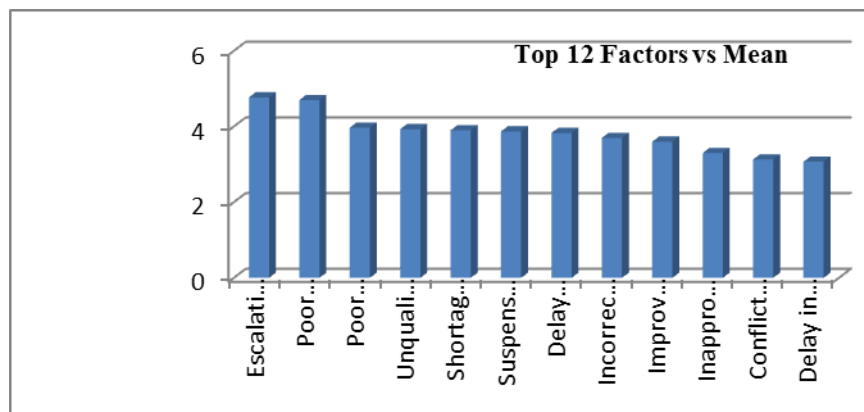


Fig.1:Ranking of factors affecting construction cost

From Fig. 1 and Table 5, the mean rank score for the Escalation of material prices is extremely high compared to other causes whereas the other significant causes include contractor's poor site management, inadequate contractor experience, shortage of site workers and incorrect planning and scheduling by contractors as discussed below.

B .Degree of agreement among the Private Engineers and Government Engineers for cost overruns groups

To determine whether there is a significant degree of agreement among the *Private Engineers and Government*

Engineers, Kendall's coefficient of concordance is used as a measure of agreement among raters. For each variable, the sum of ranks is computed. As shown in Table.6, for various factors, the p-values (where S=significant) are less than $\alpha = 0.05$ (α is the level of significance) then we reject the null hypothesis. Therefore, we conclude that there is insufficient evidence to support the alternative hypothesis. Hence, there is a degree of agreement among the Government engineers and Private Engineers.

Table 6:Kendall's Coefficient of Concordance

S.No	Factors affecting construction cost	Private Engineers and Government Engineers	
		Correlation Coefficient	P-Value
1	Escalation of material prices	0.638	0.001 S
2	Poor quality of materials and unreliable suppliers	0.65	0.001 S
3	Poor site management and supervision	0.768	0.001 S
4	Unqualified/ inexperienced labour	0.869	0.001 S
5	Shortage and slow mobilization of equipment	0.852	0.001 S

6	Suspension of work by owner and delay in payment	0.725	0.001 S
7	Delay due to Natural Disasters like flood,rain	0.689	0.001 S
8	Incorrect planning and scheduling by contractors	0.723	0.001 S
9	Improvements to standard drawings during construction stage	0.778	0.001 S
10	Inappropriate construction methods adopted by contractor	0.755	0.001 S
11	Conflicts between consultant and engineers ⁷	0.812	0.001 S
12	Delay in obtaining permits from municipality	0.891	0.001 S

*The agreement is significant at level of significant $\alpha = 0.05$, S=Significant

Table 6 clarifies the correlation coefficient for each factor of the cost overruns in the construction project between the opinions of Government Engineers and Private Engineers. The p- value (sig) is less than 0.01, so the coefficients are significant at $\alpha = 0.01$, so it can be said that the factors are consistent and valid to be measured what it was set for.

V. MITIGATING MEASURES

The following points can be recommended as mitigating measures in order to minimize and control cost overruns in construction projects:

- Engineers and Contractors are recommended to be aware about construction materials and the suppliers, so they are advised to purchase the construction materials at the beginning of work to avoid the sudden increase in the price of materials. It is also better for them to have time schedule for material delivery process to the site in order to avoid shortage or lack of materials.
- Contractors are recommended to have qualified technical staff with appropriate experience of the project in order to be able to follow the different technical and managerial aspects of the project. The staff will be more effective if there is enough numbers of engineers, technicians, and foremen, so that they will guide the labours in a proper way. It is also advised for consultant to have high qualification to give suitable instruction in a suitable time and to be able to answer any question stated by contractor to avoid cost overruns.
- Contractors are recommended to set up a computerized system to perform documentation process for all the activities in the site, so they would be able to detect performance in the work and to follow the time schedule continuously. Contractors are recommended to have a time schedule that clarifies their needs for equipments in the site, so it would be ready where needed without delay.
- Owners are recommended to revise the bid documents such as technical specifications, drawings, bill of quantities and the design of the project in a good way. This is because any discrepancy in bid documents will lead to disputes between projects parts and so delay may occur which may end in cost overrun. Pay progress payment to the contractor in time because it impairs the contractor's ability to finance the work.
- To avoid delays due to Natural Disasters like flood, rain and storm,the work (construction activities like scaffolding and formworks, whitewashing etc.,) can be rescheduled to the appropriate time and till then the materials can be stored in a secured place so that the

wastage due to washout of materials can be avoided and subsequently the cost overruns can be prevented.

- Planning and scheduling are continuing processes during construction and match with the resources and time to develop the work to avoid cost overrun and disputes.
- Contractors are recommended to monitor the quality of activities continuously and to set the required quality system in the different activities of the project so as to avoid any mistakes that may lead to rework of activities and finally cost overruns.
- Consultants are recommended to avoid centralization of decisions especially those related to consultant work because this may lead to project delay. This may lead to marginalization of site engineer and then to the occurrence of many problems inside the site. Consultants should be flexible to have a compromise between the cost and high quality in evaluating contractor works.
- Owners are recommended to have technical staff who is able to manage the different stages of any project and to follow the performance percentages, and also able to compare the actual performance with the planned one to impose realistic duration and to avoid time and cost overruns.
- Owners are recommended to revise the bid documents such as technical specifications, drawings, bill of quantities and the design of the project in a good way to avoid delay in obtaining permits from municipality. Any discrepancy in bid documents will lead to disputes between projects parts and so delay may occur leading to construction overruns.

VI. CONCLUSION

This work has been carried out to analyze the factors influencing cost overruns on construction projects in some parts of Tamil Nadu. The tests carried out were aimed at ascertaining the factors that contributed immensely to cost escalation of the construction project. Kendall's coefficient of concordance was adopted to ascertain the degree in agreement amongst all the project parties. The result of the study has shown that materials and delay due to related factors are greatly influencing factors causing cost overruns on construction projects and therefore it has been suggested that the contractors, Engineers and owners should take proper decisions. Contractors are advised to purchase right quantity and quality of construction materials at the right time. The adoption of construction methods, material and equipment requirements should be decided in a perfect manner. Proper planning should be done and executed to avoid shortages or surplus of materials and change orders in the construction work. Owners are recommended to revise the bid documents such as technical specifications, drawings, bill of quantities

and the design of the project in a good way to avoid delay in obtaining permits from municipality. Owners are also advised not to pass always some change orders in the construction activities and not to delay the payments for the work concerned persons. Finally to carry out the cost planning successfully during pre and post contract stages in all the construction activities from the start to finish in a better way, soft wares like Primavera, MS project can be also used to schedule the various construction activities and thus to predict and control the cost overruns in the construction projects.

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REFERENCES

- [1] Abdullah, M.R., A.A.A. Azis and I.A. Rahman, "Causes of delay and its effects in large MARA construction project", *Int. J. Integr. Eng.*, 1(1) 2009.
- [2] Aftab Hameed Memon, Ismail Abdul Rahman, Mohd Razak Abdullah, Ade Asmi Abdu Azis, "Factors Affecting Construction Cost in Mara Large Construction Project: Perspective of Project Management Consultant", *International Journal of Sustainable Construction Engineering & Technology* Vol 1, No 2, 2010, pp. 41-54.
- [3] Al-Hammad, A, "Factors affecting the relationship between contractors and their sub-contractors in Saudi Arabia", *Building Research and Information*, 21(5), 1993, pp.269-73.
- [4] Aibinu, A. and Jagboro, G, "The effects of construction delays on project delivery in nigerian construction industry", *International Journal of Project Management*, 20(8), 2002, pp. 593-99.
- [5] Arditi, D., Akan, G., Gurdamar, S., "Cost overruns in public projects", *International Journal of Project Management* 3 (4), pp.218-224.
- [6] Avots, I. (1983). Cost-Relevance Analysis for Overrun Control. *International Journal of Project Management*, Vol.1 No.3, 1985 142-148.
- [7] Azhar N, Farooqui RU and Ahmed SM, "Cost overrun factors in construction industry in Pakistan", First international conference on construction in developing countries ICCIDC-I, advancing and integrating construction education, research and practice, 2008.
- [8] Angelo, W. J., & Reina, P., "Megaprojects Need More Study Up Front to Avoid Cost Overruns", 2002
- [9] Cooke, B. and Williams, P. *Construction planning programming and control*. Blackwell publishing, 2004 Oxford.
- [10] Elinwa, A.U. and S.A. Buba., Construction cost factors in Nigeria. *J. Construct. Eng.Manag.*, 119(4): 1993 698-713.
- [11] Enshassi, J. Al-Najjar, and M. Kumaraswamy, "Delays and cost overruns in the construction projects in the Gaza Strip", *Journal of Financial Management of Property and Construction*, Vol. 14 No. 2, 2009, pp. 126-151.
- [12] Flyvbjerg, B., M.K.S. Holm and S.L. Buhl, "How common and how large are cost overruns in transport infrastructure projects?", *Trans. Rev.*, 23(1): 2003, pp.71-88.
- [13] Frimpong, J. Oluwoye, L. Crawford, "Causes of delay and cost overruns in construction of groundwater projects in a developing countries; Ghana as a case study", *International Journal of project management*, 2003, pp.321-326.
- [14] Hissani .A. Basoni, "Cost overruns related to the design phases in the Egyptian construction industry", *Journal of Engineering Management Research*, Vol.1 No.5, 2013, pp 138-147.
- [15] Kaming, P.F. , Olomolaiye, P.O. , Holt, G. D. , & Harris, F. C., "Factors Influencing Construction Time and Cost Overruns on High-rise Projects in Indonesia", *Construction Management and Economics*, Vol.15, No.1, 1997, pp. 83-94.
- [16] Koushki, P. A., Al-Rashid, K and Kartam, N, "Delays and cost increases in the construction of private residential projects in Kuwait", *Construction Management and Economics*, 23, 2005, pp. 285-294.

- [17] Lee S., Thomas S., Tucker R., "The relative impacts of selected practices on project cost and schedule", *Construction Management and Economics*, 23 (5), 2005, pp. 545-553.
- [18] Moura, H.P., J.C. Teixeira and B. Pires, "Dealing With Cost and Time in the Portuguese Construction Industry", *CIB World Building Congress*, 2007 ,pp. 1252-1265.
- [19] Memon, A.H., I.A. Rahman, M.R. Abdullah and A.A.A. Azis, "Factors affecting construction cost in MARA large construction projects: Perspective of project management consultants", *Int. J. Sustainab. Construct. Eng. Technol.*, 1(2): 2010, pp 41-54.
- [20] Sambasivan M. and Soon Y., "Causes and effects of delays in Malaysian construction industry", *International Journal of Project Management*, Vol.25,No.5, 2007, pp. 517-526.
- [21] Olawale, Y.A. and M. Sun., "Cost and time control of construction projects: Inhibiting factors and mitigating measures in practice", *Construct. Manag. Econ.*, 28(5): 2010, pp 509- 526

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