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Analysis of Construction Project Cost Overrun by Statistical Method

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Abstract: ***Cost overruns have been a major issue in many Indian construction projects. The successful execution of construction projects and keeping them within prescribed schedule and cost is very important for effective cost performance. Most of the construction projects suffer from cost overruns due to a multiplicity of factors. The present work is carried out on studying significant factors causing cost overruns in construction projects. A questionnaire for the survey has been prepared by Authors based on 45 common factors for cost overruns identified from literature review and discussion with experts. These factors are related with Owner, Contractor, Consultant, and Management, Material, Equipment, Labor and External.***

The cost overrun methodology presented in this study gives statistical method which is used in construction sector for computing impact of project cost overruns. The finding of the paper will help the project manager to act on critical causes and further try to reduce cost overrun of project.

Keywords: Construction projects, Factors of cost overrun, Relative important index.

I. INTRODUCTION

Throughout the world, the business environment within which construction organization operate continues to change rapidly [4]. It provides huge employment to the people and plays very significant role in country economy. Project cost overrun is most common problems in the construction industry. Project overruns due to time and cost result in delays during project execution. In developing countries project overruns is a serious where implementation of project faces many uncertainties. It result in wastage of scare financial resources, delays in providing facilities, development and also make construction costlier. With globalization and technology driven economic growth all over the world, a scientific and systematic approach to project management becomes imperative to ensure that project objectives are attained within the constraints of time and resources.

To study the factors affecting cost overruns of construction projects a questionnaire has been prepared. The feedback was taken from respondents in Pune region of Maharashtra in India. The Statistical method is carried out to understand the perception of construction's professionals in project towards factors influencing construction cost. An ordinal scale of measurement is applied for data measurement in questionnaire survey. Data is collected using develop structured questionnaire. The ranking of factor is calculated based on relative important index value.

II. LITERATURE REVIEW

Cost overrun is defined as excess of actual cost over budget. Cost overrun is also sometimes called "cost escalation," "cost increase," or "budget overrun" [11]. A list of cost overrun factors and contributing to the cost overrun associated with buildings,

roads and bridges construction is prepared based on literature review. A number of studies have been carried out to determine the causes of cost overruns in construction projects. Adnan Enshassi (2009) it was found that Construction projects located in the Gaza Strip, Palestine suffer from many problems and complex issues such as unavailability of competent staff, late delivery of materials and equipment, material shortage, waste rate of materials, escalation and fluctuation of material prices, quality of equipment and raw material, delay in progress payment, cash flow of project, cost of variation order, differentiation of currency prices, cost of rework, cost control system, poor site management, poor communication and coordination by owner and other parties, conformance to specification, project complexity, absenteeism rate through project, planned time for construction, time needed to rectify defects, inadequate planning and scheduling, mistake and discrepancies in design documents, late in reviewing and approving design document by consultant and client. Abtab Hameed Memon (2010) founded factors of cost over are lack of experience of contractor and subcontractor, Inaccurate time and cost estimate. A study on UK construction industry by Yakubu Adisa Olawale (2010) founded cost overrun factor that are lack of software, Inaccurate time and cost estimate, cash flow of project, equipment breakdown, material shortage. Similarly Ismail Abdul *et al.* (2013) found significant factor causing cost overrun in construction project are shortage of labour low productivity level of labours, lack of experience of contractor and subcontractor , equipment breakdown, financial difficulties by contractor, unclear and inadequate detail drawing, design change.

III. RESEARCH METHODOLOGY

The research methodology for present study has adopted questionnaire survey to identify significant factors influencing cost overruns in construction projects. To identify cost overruns factors, literature reviews, discussion with experts were carried out. From existing literature on the construction industry it was possible to identify certain major effects of cost overrun on project delivery. A questionnaire was then drawn up. As the outcome of review 45 factors of cost overrun were identified.

These questionnaires were distributed to Owners and Contractors of construction Industry. The data from the questionnaire was analyzed statistically. The perspective of owner and contractor has been analyzed to rank the causes of cost overruns based on their Relative important index . Relative important index method was used for hierarchal assessment of factors and found out the top most significant factors of cost overruns.

The questionnaire was designed so that it is easy to read and responses are easy to fill in. An ordinal scale of measurement will be applied for data measurement in questionnaire survey. These sections were designed to obtain the responses on a ordinal scale that indicates the relative importance of various cost overrun. Ordinal scale use in this study will be adopted from (Enshassi et al. 2009) i.e Extremely Significant (E.S); Very Significant (V.S); Slightly Significant (S.S) and Not Significant (N.S). However, abbreviation replace with numbers i.e 1 for not significant (0%); 2 for slightly significant (25%); 3 for moderately significant; 4 for very significant (75%) and 5 for extremely significant (100). will be adopted to understand the perception of personnel of the owner and contractors involved in handling construction projects. For reliability of data Authors decided the minimum experience of respondents (owner and contractor) as 10 years. The questionnaire has been given personally to the respondents and communicated to fill without hesitation or with no bias. Questionnaire has been also given to the Class I Gazette Officers or reliable colleagues.

In the study Relative Important index (RII) have been employed and calculated for ranking of causes of cost overrun in the construction project. The RII is used to rank the different causes. These rankings make it possible to cross-compare the relative importance of the factors as perceived by the two groups of respondents (i.e. owner and contractors). Each individual cause's RII perceived by all respondents should be used to assess the general and overall rankings in order to give an overall picture of the causes of construction cost overrun in construction industry.

All the numerical scores of each of the identified factors were transformed to relative importance indices to determine the relative ranking of the factors. Higher the value of RII, more important is the cause of cost overrun.

IV. DATA COLLECTION

As discussed earlier questionnaire survey have been carried out among the two major participants namely Government and Private representative from construction projects firms. The respondents involved in the survey had several years of experience (more than 10 years minimum) in handling various types of projects such as buildings, roads and bridges. Total 50 sets of questionnaires were distributed, 37 responses were received. Table-1. shows brief Summary of survey conducted. The respondents are senior employees of their companies and holding executive and managerial position. The reliability of the survey results is expected to be high because all the respondents are top-level experienced management officials in their organizations.

TABLE-1. PERCENTAGE OF QUESTIONNAIRE DISTRIBUTED AND RESPONSES RECEIVED

Respondents	Questionnaire distributed	Responses return	Percentage of responses
Owner	30	22	73%
Contractor	20	15	75%
Total	50	37	74%

V. DATA ANALYSIS AND DISCUSSION OF RESULTS

The summary of cost overrun factors and relative important index (RII) of respective factors is given in Table-2. RII value was calculated as (Enshassi and Mohamed 2009; Desai and Bhatt 2013) with the following expression.

$$RII = \frac{\Sigma W}{A \times N}$$

Where,

W = Weighting given to each factor by the respondents and ranges from 1 to 5 where '1' is 'not significant' and '5' is 'extremely significant',

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

N = Total number of respondents

Ranking of Cost Overruns : The ranking of causes of cost overrun for construction projects has been done based on relative important index (RII) value calculated for each group of respondent i.e. Owner and Contractor and also the overall respondents. Table-3 shows the top most significant factors of cost overrun ranked by overall respondents.

TABLE-2. TEN MOST IMPORTANT CAUSES OF COST OVERRUN.

SR NO	FACTORS OF COST OVERRUN	OVERALL	
		RII	RANK
1	Material shortage	0.678	1
2	Shortage of labor	0.631	2
3	Late delivery of materials and equipment	0.595	3
4	Unavailability of competent staff	0.566	4
5	Low productivity level of labors	0.541	5
6	Quality of equipment and raw material	0.541	5
7	Delay in progress payment	0.538	6
8	Financial difficulties by contractor	0.533	7
9	Poor site management	0.526	8
10	Escalation and fluctuation of material prices	0.523	9
11	Poor communication and coordination by owner and other parties	0.520	10

From the analysis of results, it was found that material shortage and Shortage of labor are ranked high by both respondent owner and contractor. These Factors are elaborated in more detail as follow.

Material shortage: Material shortage is rank 1st by overall respondent as shown in Table-3. Materials are considered as backbone of construction projects. Therefore any problem related to construction materials would significantly affect the project. To manage material shortage, schedule of material requirement should be made to indicate approximately the total quantity of all essential materials such as aggregates, cement, reinforcing steel, sand etc. to be produce. Make sure sufficient lead time for procurement of materials at best possible prices, terms and avoid emergency purchase. Complete material requirement for each month for each item as per quantities.

Shortage of labor: shortage of labor is rank 2nd in overall ranking. Construction field is getting more essential around the world. The major impacts such as construction costs increase, quality of work and the speed of construction will be slow down. Employing qualified workers is a huge burden on contractors and construction owners. The project manpower planning primarily focuses on determining the size of the project workforce, its structuring into functional groups and worker's team and scheduling the manpower. To determine the number of workers needed to perform a given job in the specified time, data- wise forecasting of the workers requirements to complete the project work and then organizing the planned work.

Late delivery of materials and equipment: It is rank 3nd in overall ranking. For effective planning of delivery of materials and equipment identify the material required, estimated quantities defining specifications, forecasting requirements, locating sources for procurement, getting material samples approved and designing materials inventory and development the procurement plan to ensure a smooth flow of materials till the connected construction works are completed at the project site.

This paper has highlighted factors and the need to reduce cost overrun by owner and contractor. Owner should facilitate payment to the contractors in order to overcome delay, cost overrun and claims. Owner may recruit competent project manager and procurement of needed materials to the contractors. There should be adequate contingency allowance in order to cover increases in material cost. Quality materials should be of a greater interest for contractors in order to improve cost, time and quality performance. This can be done by conducting quality training and meetings that are important for performing an improvement. Contractors should make available source of finance during construction project, adequate and proper materials procurement and developing human resources in the construction industry through proper and continuous training programs about construction projects cost. These programs can update participant's knowledge and can assist them be more familiar with project management techniques and processes at all levels of managerial people should participate in important decision making. There should be continuous coordination, cooperation, relationship and flow of information between all the people involve through project life cycle for resolving problems and developing project performance. Contractor should sequence the work according to schedule and also should have Cost Engineer in their projects to successful control cost.

VI. CONCLUSION

The present study identified and analyzed causes of cost overrun in construction industry in Pune region. It was observed the factors for cost overrun are the Material shortage, Shortage of labor, Late delivery of materials and equipment, Unavailability of competent staff , Low productivity level of labors, Quality of equipment and raw material. For effective and efficient cost control of construction projects the Authors recommends that material management, resource planning and management, and proper financial management may be adopted.

An attempt is made to capture the variables that best explain the occurrence and non-occurrence of cost overrun in construction projects. Statistical method could assist the decision makers in identifying factor causing cost overrun for better project development to avoid the delays and complete the project on planed schedule time.

APPENDIX

TABLE-3 RANKING OF CAUSES OF COST OVERRUN

SR NO	FACTORS OF COST OVERRUN	OWNER		CONTRACTOR		OVERALL	
		RII	RANK	RII	RANK	RII	RANK
1	Unavailability of competent staff	0.627	3	0.506	8	0.566	4
2	Shortage of lab our	0.663	1	0.600	2	0.631	2
3	Low productivity level of labors	0.563	6	0.520	7	0.541	5
4	Lack of experience of contractor and subcontractor	0.500	9	0.506	8	0.503	12
5	Late delivery of materials and equipment	590	5	0.600	2	0.595	3
6	Material shortage	0.636	2	0.720	1	0.678	1
7	Waste rate of materials	0.481	11	0.453	12	0.467	20
8	Escalation and fluctuation of material prices	0.500	9	0.546	5	0.523	9
9	Equipment breakdown	0.472	12	0.546	5	0.509	11
10	Quality of equipment and raw material	0.590	5	0.493	9	0.541	5
11	Low level of equipment operating skill	0.481	11	0.400	16	0.440	26
12	Lack of software	0.345	23	0.346	20	0.345	41
13	Market share of organization	0.372	21	0.426	13	0.399	36
14	Delay in progress payment	0.490	10	0.586	3	0.538	6
15	Profit rate of project	0.381	20	0.426	13	0.403	35
16	Cash flow of project	0.472	12	0.546	5	0.509	11
17	Project design cost	0.454	14	0.413	15	0.433	30
18	Material and equipment cost	0.518	8	0.466	11	0.492	13
19	Cost of rework	0.381	20	0.560	4	0.470	18
20	Inaccurate time and cost estimate	0.500	9	0.480	10	0.490	14
21	Liquidity of organization	0.472	12	0.386	17	0.429	31
22	Cost of variation order	0.372	21	0.360	19	0.366	39
23	Overhead percentage of project	0.363	22	0.360	19	0.361	40
24	Differentiation of currency prices	0.481	11	0.413	15	0.447	23
25	Project lab our cost	0.409	19	0.480	10	0.444	28
26	Project over time cost	0.336	24	0.453	12	0.394	37
27	Motivation cost	0.454	14	0.306	21	0.380	38
28	Regular project budget update	0.472	12	0.400	16	0.436	29
29	Cost control system	0.545	7	0.426	13	0.485	15
30	Inadequate planning and scheduling	0.434	17	0.533	6	0.483	16
31	Improper construction method by sub contractor	0.563	6	0.373	18	0.468	19
32	Financial difficulties by contractor	0.600	4	0.466	11	0.533	7
33	Poor site management	0.600	4	0.453	12	0.526	8
34	Poor communication and coordination by owner and other parties	0.481	11	0.560	4	0.520	10
35	Conformance to specification	0.409	19	0.466	11	0.437	27
36	Project complexity	0.418	18	0.400	16	0.409	33
37	Absenteeism rate through project	0.445	15	0.413	15	0.429	31
38	Unclear and inadequate detail drawing	0.463	13	0.480	9	0.471	17
39	Planned time for construction	0.436	16	0.413	15	0.424	32
40	Mistake during construction	0.436	16	0.466	11	0.451	22
41	Design change	0.463	13	0.426	14	0.444	25
42	Time needed to rectify defects	0.463	13	0.453	12	0.458	21
43	Mistake and discrepancies in design documents	0.409	19	0.400	16	0.404	34
44	Delays in producing design document	0.436	16	0.466	11	0.451	22
45	Late in reviewing and approving design document by consultant and client	0.372	21	0.520	7	0.446	24

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