

Analysis of Cost Variation between Estimated Cost and Actual Cost of Building Project

¹Mr. Chougule P. S., ²Prof. Desai D. B., ³Prof. Patil S. S.

¹PG Student, ²Associate Professor, ³Assistant Professor
Civil Engineering Department,
Dr. J. J. Magdum College of Engineering,
Jaysingpur, Maharashtra, India.,

Abstract— Construction can be considered as a dynamic industry which is constantly facing uncertainties. A construction project is usually considered successful if it is completed within its time, budget & quality targets. Cost-variation has become an integral part of construction projects worldwide. Cost variation can be explained as an instance in which the provision of contracted goods or services are claimed to require more or less financial resources than was originally agreed between a project sponsor and a contractor, i.e. the difference between the original cost and the actual cost when the project is completed. This thesis presents a study made on causes, effects and controls of cost variations in building projects. To achieve the study objective, I carried a literature review of the subject covering periodicals, dissertations, previous research studies and books written on the subject of change in cost variation orders as well as discussions with the practitioners in construction industry. In light of the literature study I developed a survey questionnaire. The questionnaire was distributed to all building contractors and consultants, builders and developers and architects. The first included questions on the general market characteristics and general information. The second included questions on the possible causes of cost variations as divided into six different categories which are finance, management, labour, material, project and other. Response from 31 participants working in the field of building construction projects was analyzed. For the analysis of this dissertation work relative importance index (RII) method is used. Analysis of data indicated that cost variations due to change orders were in magnitude of about 10% of the original estimated value. The study concluded various causes of cost variation and which are the most effective causes of variation. The causes which are having RII more 0.6 are considered as severe causes and the problem statement and its recommendations are described. Liquidity of organization, design change or change orders, shortage of materials, number of workers, cost of rework and project size are found to be the main causes of change in cost variation between estimated and actual cost of building projects. After analyzing causes of cost variation of building projects it will be easy to manage the project effectively so as to minimize the possibilities of cost variation. This study will provide a solution for management of construction project cost by minimizing the cost variation possibilities in construction industry.

IndexTerms— Cost Variation.

I. INTRODUCTION

The term cost variation is defined as difference between actual cost and estimated or budgeted cost. Cost variation is defined as the excess in actual cost as compared to the original cost estimate initially made for a project (Tejale, 2015). Cost variation is defined as an increase of cost which is not expected (i.e. excess of a budgeted cost) during estimation of the initial budget. It is the phenomenon in which the client has to spend more money for the completion of project than the originally estimated i.e. the project goes over the budget. Cost variation is the difference between the final and originally estimated (i.e. initial, expected or estimated) cost of the projects. The originally expected cost is called the initial project cost and also called estimated cost of project works. Estimated costs are defined as budgeted or forecast costs which are made at the beginning of the project to build a project. Even if the project planning and scheduling process varies with project type, time and country, it is possible to locate for a particular project a specific point in the procedure that could be identified as the time where the formal decision is made to build the project. Actual cost is defined as real, accounted cost determined at the time of completing a project. Costs variation is an occurrence in which the provision of contracted projects, service or goods are claimed to require extra financial resources than initially agreed between a project owner and a contractor.

II. OBJECTIVES OF STUDY

- To study and identify the factors affecting cost variation between estimated cost and actual cost.
- To conduct a questionnaire survey in construction industry to identify the factors responsible for cost variation in estimated cost and actual cost and categorizes them according to their extent of impact.
- To conduct feasibility study for the above identified factors and their impact by taking case study.
- To give suggestive recommendations in order to reduce cost variation between estimated cost and actual cost.

III. COLLECTION OF CAUSES

Causes are collected from two sources-

- *Literature survey:*

First, an international literature survey was performed to create an initial pool of possible causes for cost variations in construction projects. This literature survey encompassed dozens of journal articles. Any potential cause for cost variations in construction mentioned in these references had been added to the list. The literature survey yielded ample number of potential causes (Daniel and Aniekwu, 1988).

- **Discussion with guide and experts practicing in this construction industry:**

In a parallel route local expert survey was carried out. The experts were not exposed to the previous findings of the international literature survey. Their answers pertained to the local, city-specific circumstances. This discussion yielded 36 potential causes. The first focus phase of the dissertation consisted of categorizing, filtering duplications, and merging similar or closely related causes (Tien-Choon, Connie, Godwin and Omar, 2016).

IV. QUESTIONNAIRE DESIGN

The questionnaire is designed carefully to obtain the required data from the respondent that serves to achieve the dissertation objectives. The present status of construction industry with the help of literature review was used to form the questionnaire. The main data required for this dissertation is divided into two main categories. The first category is related to the information about the respondent's characteristics and their involvement in the construction industry. The second section includes cost variation causes that were collected earlier to which respondents give their opinions on the severity of certain causes of construction cost variation in building projects. This section contains 6 categories in which 36 cost variation causes are classified (Jansu and Xavier, 2015). For each factor, the respondents were requested to answer the severity impact of it cost. A six-point scale of 0 to 5 was considered for evaluating the 36 impact of each factor (Mhando, Mlinga and Alinaitwe, 2015)

V. SCORING SYSTEM AND METHOD OF ANALYSIS

In the questionnaire, an Ordinal scale of measurements is applied for data measurements in questionnaire survey. Ordinal scale used for this study includes Never; Less; Sometimes, Average, Often and Always. In the study Relative Important index (RII) have been employed and calculated for ranking of causes of cost variation 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 variation in construction industry (Tejale, 2015). 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 variation. Following formula is used for the calculating the Relative Importance Index (RII) for different causes

$$\text{Relative Importance Index} = \frac{\sum W}{A \times N}$$

Where, $0 \leq \text{RII} \leq 1$

W= Score given to each cause by respondent ranges from 0 to 5 where 0 is not affected and 5 is extremely affected.

A= Highest Score i.e. 5 in this case

N= Total No. of respondents.

VI. METHODOLOGY

To achieve the objectives of this research, questionnaires were deemed to be the most effective tool for gathering information. This study was carried out based on a literature review and a questionnaire survey. The data were collected through questionnaires, which were distributed personally to selected groups of 50 respondents (mainly people who work for construction companies/ firms who enjoy a leading role in planning and construction management, e.g., project managers, general managers, civil engineers, site managers, site engineers, supervisors) from government, construction and consulting companies and firms in the defined area of study.

VII. ANALYSIS AND DISCUSSIONS

1. Case Study

'The Kanak' is a residential and commercial building project taken for this study. This residential and commercial project is having total plot area 696.5 Sq. m and total built up area 693.57 Sq. m. The total saleable area is 1603.16 Sq. m (17250 Sq. ft) saleable area. This building consists of 5 floors excluding basement, the ground floor and basement area is used for commercial and parking purpose while the remaining floors are used as residential purpose. The total estimated cost of the project was Rs. 1.825 crores, but in present scenario the total cost of the project has gone up to around 2.04 crores. The cost variation in this project is about 11.77%.

Table 1: Total Cost Variation in Construction Project

Sr. No.	Cost Varying Factors	% Cost Variation
1	Liquidity of organization	4.16
2	Interest rate	2.19
3	Design change	1.40
4	Unexpected ground conditions	1.10
5	Underestimation	0.97
6	Construction management cost	0.82
7	Shortage of material	0.55
8	Mistakes during construction and other expenses	0.55
	Total cost variation	11.74

2. Participation in the Questionnaire Survey

The questionnaire was distributed to contractors and consultants, builders and developers and to architects those are participated in various construction projects. Hand-to-hand delivery is preferred to improve the response rate and to encourage respondents. Moreover, phone calls are frequently made to remind respondents to complete the questionnaire. A total number of 36 questionnaire sets were aimed to be distributed to individuals; i.e., 15 builders and developers working for the client, 15 for consultants and contractors and 6 for architects. But however a total of 31 numbers of questionnaires were collected from the professionals working in this industry. The subject got a great interest from the concerned contractors, consultants and clients because it attempts to investigate a problem they are facing in their projects and they are the main beneficiaries from the research results and as a result an overall participation of 86.11 % is achieved.

3. General Profile of Respondents

Contractors and consultants, builders and developers and architects are professional respondents of the building projects. The demographic characteristics of the respondents surveyed in this research, that is their organization's experience in building construction projects, and the position of the respondents within their organization are presented in Figure 1.

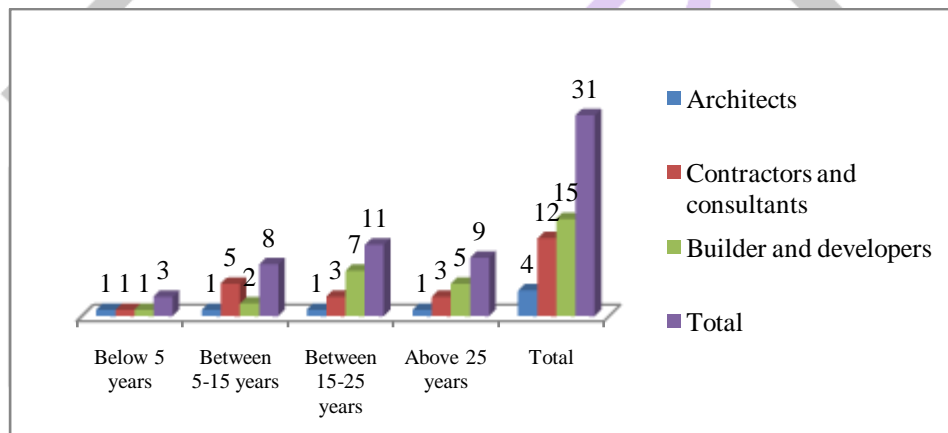


Figure 1: Graph Showing the Range of Experiences of the Respondent's Organization Involved in this Research Survey

4. Identification of Causes

The ranking of causes of cost variation for construction projects has been done based on relative important index (RII) value calculated for each category. These categories are essential in identifying and enumerating the significant causes of variations and their causative agents in building projects as discussed further.

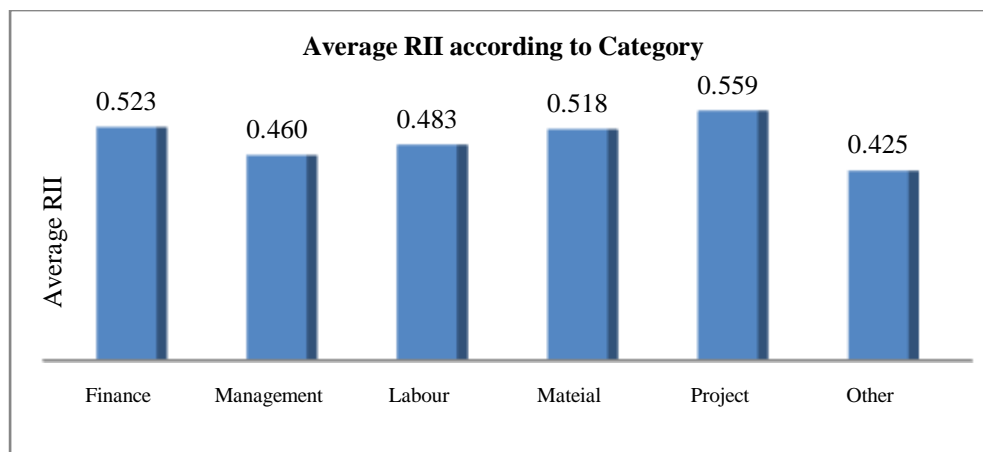


Figure 2: Graphical Representation of all Categories and their RII

Cost Variation Factors	Total Score	RII	Overall Rank
Liquidity of organization	158	0.849	1
Design changes or change order	156	0.839	2
Shortage of material	144	0.774	3
Number of workers	133	0.715	4
Cost of rework	125	0.672	5
Project size	112	0.602	6
Quality of finishing or completing work	108	0.581	7
Project location	108	0.581	8
Site characteristics	105	0.565	9
Transportation of material	102	0.548	10
Damage or wastage of material	100	0.538	11
Project type or nature	99	0.532	12
Demand and supply	97	0.522	13
Inappropriate contractors	95	0.511	14
Storage of material	95	0.511	15
Mistakes during construction	94	0.505	16
Construction equipment	94	0.505	17
Unexpected ground condition	94	0.505	18
Inflation	91	0.489	19
Taxes and interest rates	85	0.457	20
Number of stories or floors	85	0.457	21
Unavailability of competent staff	83	0.446	22
Disputes	83	0.446	23
Forms of procurement	83	0.446	24
Health and safety cost	81	0.435	25
Land cost	80	0.430	26
Incentives	76	0.409	27
Construction management or management cost	75	0.403	28
Absenteeism rate	71	0.382	29
Inspection and testing	65	0.349	30
Time needed to rectify defects	65	0.349	31
Predetermined underestimations	63	0.339	32
Force majeure	63	0.339	33
Labour strikes	59	0.317	34
Items manufactured offsite	57	0.306	35
Deflation	55	0.296	36

VIII. CONCLUSIONS

Construction projects are subject to risks and uncertainties which affect project targets (cost, time, quality and safety). Almost every project suffers from the problem of cost variation. Most of the construction projects in all countries of the world are subject to variations in cost, and return this thing for many reasons. The reasons for cost variations may have a background of technical, financial, management related, social, political or economic nature, etc. Cost variations are very unique in nature varying from project to project due to the different circumstances each project is subjected to. The objectives of conducting this study were to discover the major causes of cost variation or variation orders in the estimated cost and actual cost of building project.

Various national and international literatures were studied, and the data related to causes of variation orders and their rankings were gathered based on a literature review. Then the findings were surveyed based on a questionnaire administered to the professionals in construction industry. In this dissertation, I have studied various factors affecting the cost of projects from previous studies and literatures referred. The cost varying factors are liquidity of organization (punctuality of periodical payments and availability of management and finance plans), inflation, deflation, uncertainty of taxes, interest rates, predetermined underestimations, design change orders, absenteeism rate, competent staff, quality of work, type of project, size of project, project location, site condition, experience and incentives, project specifications, weather, social and cultural impact, religious regulation, transportation cost, shortage of material, storage, health and safety, force majeure, etc. The factors were collected by discussions with guide and professionals in construction industry.

Considering these factors a questionnaire was formed to study the practicality and the impact of each factor on cost variations and was distributed amongst the professionals. As the main methodology to collect the data was survey of questionnaire amongst the expert, the response rate received was 86%. Out of total 31 respondents, 20 respondents are having experience of more than 15 years of construction industry. Also more than 45% of the respondents had worked on the projects costing in crores. The factors were divided into six categories to study their impact and the analysis was done using relative importance index method. After analysis of data collected from questionnaire survey, the project category and finance category are the main categories responsible for cost variations amongst the six categories. All the factors were analyzed and were ranked according to their impact. The factors with RII more than 0.60 are considered as severe causes for cost variations in building projects and are further studied. Those severe causes are liquidity of organization, design change or change orders, shortage of material, number of workers, cost of rework and project size.

A case study is also referred in this project to check the feasibility study of the identified factors and the impact of these factors on the cost of the project. What are the problems that are responsible for these factors to cause severe cost variations are studied and recommendations are suggested.

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