LITERATURE REVIEW ON COST OVERRUN IN KERALA BASED CONSTRUCTION INDUSTRY

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ABSTRACT

Every construction company is targeted to acquire money and profit at the end of each project. This is achieved by completing projects within the expected cost, time and quality targets. Cost overruns represent a constant source of concern for project developers and several researches have been developed in order to identify causes of these kind of deviations worldwide. In this paper, a literature review was conducted in order to identify the most significant factors that leads to cost overruns in construction projects and the methods applied to identify them. The results include a synthesis of factors that leads to cost overrun and a critical evaluation of different investigations and recommendations for future research. From literature review ,27 prominent factor that lead to cost overrun were identified.

Keyword : - *Cost overrun , Construction projects*

1. INTRODUCTION

Cost overrun is considered as one of the most important problems that affect construction projects progress, since it reduces the profit leading to enormous losses, and leaving the project in great troubles. Construction cost is one of the peak criteria of success of a project throughout its lifecycle and is of high concern to those who are involved in the construction industry. Cost overrun is common in infrastructure, building, and technology projects all over world. 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. Construction industries play a vital role in the development of the economic growth of a country. In recent times, it has been witnessed that the construction industry has become one of the leading industries in the globe. The increasing complexity of the construction projects shows a greater demand on construction managers to deliver projects on time, within planned budget and with high quality.

1.1 COST OVERRUN IN CONSTRUCTION INDUSTRY

When a project is completed at a cost higher than budgeted cost, that experience is called budget or cost overrun. It occurs when a project slipping over its planned schedule and is considered as a common problem that is faced by both macro and micro construction industries. Handling projects within the contract stipulated time is one of the important turning points to a successful project[14]. Therefore, a cost overrun is treated as the margin between the initial project cost expected and the real final costs. Cost overruns do not vary by project type, procurement method and contract value [16]. The project performance is mainly influenced by managerial effectiveness and sophistication of the client and the their representatives in terms of creating and maintaining positive project team relationships between contractor and design teams [16]. Shortage of skilled project managers emerges as the root cause for time and cost overruns in a project lifecycle [13]. cost overrun are fuelled by frequent changes in design and weak procurement planning, which can be mitigated by adequate training and coaching of project managers[13]. As a result cost uncertainty analysis is an important feature of cost estimation that helps decision makers to understand not only the potential funding exposure but also the nature of risks for a particular project or program[25].
Usually obtained uncertainty is due to

- Uniqueness (no similar experience)
- Variability (trade-off between performance measure like time, cost and quality)

- Ambiguity (lack of clarity, data, structure and bias estimates)

Without considering the uncertainty obtained, there is a high risk that the actual cost of a project exceeds what is originally figured, which is in turn causes several other risks such as delays and performance problems[25].

1.2 LITERATURES ON COST OVERRUN IN CONSTRUCTION INDUSTRY

Ahmed Senouci et al.(2016) has explained cost overruns and delays in Qatari public construction projects. The data collected from Qatar public work authority ASHGHAL includes 122 public road, building, and drainage projects. ANOVA method was used for data analysis and inference. Regression analysis was used to establish the relationships between contract prices and cost overruns and to predict models for calculating overruns. Based on the analysis, the cost overruns and delays were not significant at a significance level of 0.05 with respect to project type category and size.

Trefor P.Williams et al.(2014) had explained the prediction of cost overrun using data mining classification algorithms. This model used only numerical data for predictions with lower precision and recall. Modeling results found that a stacking model that combined the results from several classifiers produced the best results. The model developed has an average accuracy of 43.72% for five model runs.

Ismail Abdul Rahman et al.(2013) had focused on the effect of various factors on budget overrun in construction projects in Malaysia. In this a quantitative method is used for data collection using structured questionnaire survey amongst contractors, consultant and clients. The data was analyzed with an advanced multivariate method of structural equation modeling with PLS approach using Smart PLS software. The analysis showed that all the constructs in model contributes significantly to budget overrun with R2 value of 0.623.

Gul polet et al.(2014) has focused on micro-scaled construction companies. The data was collected through questionnaire survey within 136 companies .Reliability and ranking method was carried out for data analysis .According to him design factor plays the most critical problem for cost overrun. The findings of his study can help micro-scaled construction companies to know and prevent the root causes of cost overrun.

Zayyana Shehu et al.(2014) prepared an analysis of cost overrun on Malaysia based construction companies. A questionnaire survey of Malaysian quantity-surveying consultants was undertaken to obtain project characteristics and cost performance data, in relation to a sample of 359 recently completed construction projects. Data was analyzed based on, project sector, contract values, type of project, procurement route, nature of projects and tendering method used for analysis. The findings offer stakeholders descriptive statistical cost performance information in relation to these characteristics. The data was analyzed through regression and descriptive analysis.

Mulenga mukuka et al.(2015) discussed the effect of construction schedule overrun in Gauteng construction projects in South Africa.The data was derived from both primary and secondary sources. The primary was well prepared questionnaire and the secondary data includes detailed literature survey. MIS method was used for data analysis. The study concluded that extension of time, loss of profit, dispute, poor quality of work, claims, delays are the major criteria for project schedule overrun. Extension of time ranked 1(SD=0.829) and the last rank goes to loss of skilled employees (SD=1.077)

Ghulam Abbas Niazi et al. (2015) identified the significant factors that lead to construction cost overruns in Afghanistan. The questionnaire was circulated to 75 construction practitioners, including clients, consultants and contractors. Causes are determined based on different categories such as contractor, client, ,labor, material and equipment's and external things .RII (Relative Importance Index) method was used for analysis. According to them Corruption was ranked as first major contributor of cost overrun with a RII value of 0.89. Corruption constitutes a serious threat to the Afghanistan Construction Industry being able to improve because it has a serious effect on construction cost growth. Delay in progress payment by the client, this factor was ranked the 2nd most significant contributor of cost overrun with a RII value of 0.82.

Peter E. D. Love et.al (2013) explained the probability of project cost overrun in 276 Australian construction projects. The Kolmogorov-Smirnov, Anderson-Darling, and chi-squared nonparametric tests were used to determine the goodness of fit of the selected probability distributions. An ANOVA test was used to determine differences

between the cost overruns experienced in the construction and engineering projects (p =0.05). The contract award as the reference point, cost overruns from 276 construction and engineering projects were calculated and revealed a mean cost overrun of 12.22%.

Abhishek Bhargava et.al (2010) proposed analysis based on Time and Cost Overruns in Indiana highway projects using three-stage least-squares technique to investigate the factors affecting time delay and cost overrun against the background of their simultaneous relationship. They identify a number of factors that significantly affect cost overrun and time overrun and the effect of these variables vary by attributes such as project type and results of the bidding process Three-stage least-squares regression models was used to explain cost overrun and time delay as a function of variables that are available at planning phase. This study provides empirical evidence that a simultaneous relationship does exist between cost overruns and time delays, and therefore the prediction of cost overrun and time delay is best carried out.

A. M. El-Kholy (2015) studied two models for predicting cost overrun in Egypt based construction projects. The first model based on regression analysis and the second model was case based reasoning (CBR) model. CBR method was used to estimate percentage cost overrun in construction works. Based on the first method 20 projects was used for model building, while the data of remaining 10 projects was used for validation purposes.. The second model was based on case based reasoning. After comparing of the two model he concluded that regression model has prediction capability higher than that of CBR model in predicting cost overrun percentage for construction projects.

K.C. Iyer et.al (2005) studied the factors affecting cost performance in Indian construction projects. Questionnaire survey was conducted based on the factors affecting cost performance of Indian construction projects. Factor analysis of the response on the 55 success and failure factors are identified through literature review and personal interview . Analysis was carried out using RII method (Relative importance index). Through analysis he concluded that coordination among project participants was the most significant factors which have the maximum positive influence on cost performance in construction project.

Jose Ramon San Cristoba (2014) studied the cost allocation between activities that caused delays in a project using Game theory. The construction sector represents one of the most dynamic and complex industrial environments where conflicts among builders and owners are very common particularly in a bidding or claiming situation where owners, builders and contractors pursue their own interests at the expense of the others, leading to conflict or cooperation. The time required to complete the project was usually greater than the time specified in the contract. Because of the overriding importance of time for both the owner and the contractor, delays are the source of frequent disputes and claims among owners, clients and consultants, leading to lawsuits. There was a general consent between theorists that Game theory provides, by its very nature, the appropriate tools for the analysis and eventual solution of conflicts of any kind. The course of a conflict as well as its resolution depends on the decisions made by the various factors involved. Each party, when considering is decisions, should take into account the decisions made by all the other parties. Game theory is a natural tool that can be used in such interactive situations where the results of the interaction depend on all the players' decisions. Despite the extensive literature devoted to the delay is acknowledged as one of the most common, costly, and risky problems, and the source of frequent disputes and claims among owners, clients and consultants leading to lawsuits. Such situations usually involve questioning the facts, causal factors, contract interpretations and quantum of the claims. Since the ability to make a claim is very much based on what the contract says about delays, contractual documentation needs to reflect the particular nature of each project in order to prevent disputes and claims. Analysis was based on game theory and it was applied to road building project to identify the activities that are responsible for delay in the project and divide the costs among them. Using the model presented in this paper, a wide variety of project situations can be modeled and placed as contractual obligations. The number of variables, equations, and Inequalities needed to model these real-life situations will depend on the complexity of the problem.

Peter E. D. Love et.al(2015) describes cost overruns experienced in 49 road construction projects procured using traditional lump contracts in Australia. The theoretical probability distributions are fitted to cost overrun data derived from the sampled projects whose contract values ranged from AU $0.5 and AU $97 million. Goodness of fit tests were used in conjunction with probability-probability plots to compare the sample distribution from the known theoretical distribution. A log logistic probability density function was found to best describe the behavior of cost overruns. The cumulative distribution function was used to determine the probability of a cost overrun being experienced from the point at which a contract was awarded. The public sector clients can determine an appropriate contingency at contract award, which takes into account to increasing project costs. A one-way analysis of the

variance (ANOVA) of cost overruns was undertaken to examine differences between contract values as previous research has indicated that a cost overrun is related to project size. The research revealed a mean cost overrun of 13.55%.

Abhishek Bhargava et.al (2010) described an empirical evidence that a simultaneous relationship exists between cost and time overruns from Indiana highway projects using three-stage least-squares technique. In this they identify a number of factors that significantly affect cost overrun and time overrun and they show how the effect of these variables vary by attributes such as project type and results of the bidding process. The models developed in this paper can help agencies enhance the estimation of the expected overruns of final cost and the delay in completion time for their planned projects. The impact of various explanatory factors on cost overrun and time delay was studied separately for bridge, maintenance, roadway reconstruction, pavement resurfacing, and traffic projects. This was done to show that the cost overrun or time delay for the different project types can generally differ due to the inherent construction practices and planning processes associated with each project type. The findings of this paper will assist highway agencies in significantly improving the process of construction cost and time forecasting during the planning phase, thereby making decisions that will yield benefits of reduced cost overruns and time delays, and ultimately result in enhanced highway project programming, reduced exposure to litigation, and enhanced public relations of the highway agency.

Ying-Mei Cheng (2013) proposed Modified Delphi Method and Kawakita Jiro method (KJ) for determining the cost-influencing factors to consolidate the experts' opinions and identify and rank the key factors that affect project costs. The Delphi method is suitable for extracting usable data from personal experiences which can be transformed into empirical data The KJ method is a qualitative technique developed by Kawakita Jiro. It adopts the bottom-up sorting process and is very useful for classifying data. Ninety cost-influencing factors are collected from literary review and interviews with experts with practical cost control experiences in the construction companies (Group 1). The KJ method was used to consolidate the factors into 4 categories and down to a total of 42 factors. 2 rounds of questionnaires are then conducted to filter the key factors. In order to verify views of those in the first group, Group 2 consists of experienced experts from the public sectors, consulting firms and construction companies as a comparison. Results of the analysis indicate that there are 16 key cost-influencing factors. Severity Index computation was then adopted to rank these key cost influencing factors. The study renders that clearly defined scope of project in the contract and cost control are the major determinants for cost overrun.

2. CONSTRUCTION PROJECT COST RISK ANALYSIS USING BAYESIAN NETWORK

Several techniques and models had developed to support project cost estimation. Most common quantitative techniques for modeling risk and uncertainty in project cost analysis are Regression modeling, Artificial Neural networks, Feature – based method and case based method. But the cost items may not be independent that means the high cost of one element may affect the cost of another. So it is difficult to applying quantitative risk methods. In order to consider the dependencies and correlations between the cost items, a quantitative assessment framework is formed called Bayesian network. It is a powerful tool for knowledge representation and reasoning under conditions of uncertainty and visually presents the probabilistic relation among a set of variables. It consists of qualitative and quantitative parts. The qualitative part is also called structural learning which means the graphical representation of independence holding among variables and has the form of a directed acyclic graph. The quantitative part is also called parameter learning, finds dependence relations as joint conditional probability distributions among variables using cause and consequence relationships from the qualitative part and data of variables[25]. the network in Bayesian method is a graph, which consist of a set of nodes and arrows. The nodes is used to represent probabilistic variables and the starting node is called parent node. The other nodes, which have inward arrows connected to them. In order to carry out the calculation it is necessary to define the states and probabilities for each node. This method is based on Bayes rules (from cause to effect as well as from effect to cause).

2.1 LITERATURES ON CONSTRUCTION PROJECT COST RISK ANALYSIS USING BAYESIAN NETWORKS

Van Truong Luu et al. (2009) describe the probability of construction project delays in using Bayesian belief network in Vietnam construction project. 16 factors were identified through a questionnaire survey of 166

professionals. The result was analyzed using Bayesian belief network. The validity of the proposed model is tested using two realistic case studies. The findings of the study revealed that financial difficulties of owners and contractors, contractor's inadequate experience, and shortage of materials are the main causes of delay .BBN method was analyzed using two phases- Quantitative phase and qualitative phase. Qualitative phase was to identify significant delay factors being applicable to the context of construction projects . A set of factors was initially identified from the published literature and brainstorming sessions with experts. Quantitative phase are to determine the cause and- effect relationships among factors identified in the qualitative phase, to develop the BBN-based model, and to estimate the probability of delays in construction.

Vahid Khodakarami et.al (2013) proposes a assessment for integrating the inference process of Bayesian networks to the traditional probabilistic risk analysis. It provide framework for presenting relationships and enable probabilistic inference among a set of variables. The aim of the paper was to find how advanced artificial intelligence tools such as BN can be employed to capture complex issues such as uncertainty in project cost analysis. The creative a model considering the input data as Cost items and all possible common causes to cost items.

Marian W. Kembłowski et.al (2017) describe the risk assessment in constructing tunnel under the Dead Vistula river in Gdank using Bayesian Networks. In this assessment factors that lead to risk events (background info), as well as the information about the risk symptoms (monitoring info) are taken. For computer simulations they are used Netica software. In this case special type of risk assessment are carried out such as identified the risk of damage to Tunnel Boring Machine, the risk of collisions of the construction work with existing underground networks, as well as the risk of damage to the existing adjacent facilities. They made more concentration on customer side. The decision depends on three main decision variables such as damage of Tunnel Boring Machine, collisions with underground utility networks, and damage to buildings in the neighborhood. The decision variables are affected by previous data. For the TBM this is the evidence of past damages of failures of TBM. For the background they use geographical data, such as the evidence of past collisions with underground utility networks in the area, and past damages to adjacent buildings etc. Through the investigation they concluded that risk sources one can consciously evaluate and how the source disturbance will affect the final result. BBN can be easily used to evaluate and compare the effects of various factors easily.

Rita L. Sousa et.al(2012) presents a methodology to systematically assess and manage the risks associated with tunnel Construction in Porto Metro in USA. Analysis was carried out using Bayesian geology prediction model. The geological prediction model allows one to predict ahead of the tunnel face, and based on this, it is then possible to decide on the optimal construction strategy The first phase of Porto Light Metro Project consisted of 4 lines with al length 70 km. The project has two lines (Line C and Line S) that included tunnels that run beneath the Centre of the city. The Line C tunnel was 2.3 km long and the Line S tunnel was 3.7 km long. Prediction was carried out based on the existing geological survey and geological profiles. The aim of the model was to act as a decision aid for assessing and mitigating risk. First, the geology prediction model was applied from ring 336 to1611 ring identifying soil (G1) and rock (G3). In the case of soil, 77.2% of the rings sections that consisted of soil were correctly identified, 20.4% were misclassified as mixed and 2.4% as rock. Second, the geology prediction model was used to predict the geological conditions between rings 104 to 335. A decision support framework for assessing and avoiding risks in tunnel construction was developed and successfully implemented in this case study.

W.S. Jeager et.al describes a Bayesian network approach for coastal risk in wells-next sea, Norfolk,UK. BN estimated the percentage of affected receptors in different zones of the site by predicting their hazards and damage. Typical source variables, or boundary conditions, are peak water level, maximum wave height and peak period, and storm duration etc where analyzed for carry out risk assessment. BN results for a storm of 4.41 m water level and 2.17 m significant wave heights. 93.55% of residential properties had no flood inundation and therefore sustained no damages. Commercial properties were at a greater risk in this scenario with 36:6% of commercial properties experiences some flooding with no DRR measures .He concluded that through the BN they are able to predict onshore hazards and impacts, when provided with evidence of the offshore boundary conditions of a storm .

Nieto-Morote et.al (2010) studied risk assessment methodology based on Fuzzy Sets Theory. It an effective tool to deal with subjective judgment, and on the Analytic Hierarchy Process (AHP), which was used to structure a large number of risks. factors are expressed by qualitative scales which are defined by trapezoidal fuzzy numbers .The procedure includes definition and measurement of parameters, Definition of fuzzy inference, Defuzzification. As a result of the study risk assessment group have identified and 13 risks classified into four groups. He concluded that the cost of the process of development of actions to reduce threats to the project objectives was very high. For this

reason, the process of prioritizing risks was critical. Risk response must be focused on the risks such as Lack of adequate process, Inexperienced team members, Design error and 'Delay in supply. These data demonstrate that project management team must be paid special attention to the composition of the risk assessment and its activities.

Feng et al. conducted a theoretical framework on major participants in the construction industry and their approaches to risks. The study compared the major participants of client, design team, contractor and project manager involved in construction projects based upon their characteristics and the risk management approaches they implement. These characteristics will then be aligned with their use of formal risk management tools or lack thereof. In the next stage they used questionnaire to collect the primary data via the internet for in order to identify the number of respondents that will be required, statistical analysis and their geographic distribution.

3.RESULT AND DISCUSSION

A cost 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. From the literature survey 27 prominent factors lead to cost overrun were identified. They are

Table-1: List of factors identified from literature reviews

sl.no	causes	sl.no	causes
1	Unexpected inflation/Material price escalation	15	Additional work/Direct change orders by client
2	Inaccurate estimates	16	Bureaucracy and political interference in tendering method
3	Improper planning and scheduling	17	Inadequate monitoring and control
4	Fluctuation in prices of labor	18	Increase in cost of skilled labor
5	Adverse effect of weather	19	Project materials monopoly by some suppliers
6	Poor contract documentation and management	20	Disputes/Strikes/Accidents on site
7	Lack of experience	21	Delay in inspection and approval of completed works
8	Design risk/Frequent design changes	22	Work suspension because of litigation
9	Inadequate labor/skill availability	23	Mistakes during construction
10	Change in the scope of the project	24	Insufficient numbers of equipment, tools and plant
11	Mode of financing and payment for completed work	25	Changes in material specification and type
12	Contractor's poor procurement processes	26	Monopoly and change of technology
13	Technical incompetence and poor organizational structure	27	Rework due to poor work/wrong materials by the contractor
14	Inappropriate government policies		

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