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Prediction of time and cost contingency in construction projects

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Abstract— Construction delays and cost overrun in building projects are caused by various personnel's like owner, contractor, or a third party in which several types of overruns may occur concurrently. Even though construction project scheduling and estimating has received extensive attention of researchers, time and cost contingency was not treated well in the literature. In order to meet the deadline of a project, scheduling and budget estimating should be flexible enough to accommodate changes without destructively affecting the overall project cost and duration. As such, this report aims to identify, study and review the effect of the factors that affect time and cost contingency. This report presents methodology of the project. The factors that influencing cost and duration of construction projects are identified from literature survey and from the experienced persons involved in construction industry. Based on the factors identified, Questionnaire is framed and distributed to various companies and professionals. Respondent of questionnaire survey are Owner/ Quantity surveyor/ Project manager/ Planning engineer/ Contractor/ Assistant engineer. SPSS software is used for statistical analysis of the collected data to find out the top most factors that have large impact on construction suggesting the use of contingency in construction projects. The top 7 factors are used as system attributes for neural network modeling. The data have been trained and tested and finally model verification was done to predict the contingency values.

Keywords—Overrun; scheduling; estimating, contingency, trained

I. INTRODUCTION

Nowadays more number of building projects and new infrastructures are being built on a large scale which then contributes to the fiscal growth of the country. Construction industry faces enormous uncertainties. Dealing with risks and uncertainties is usually a problem for both contractors and proprietors. This situation might end up with significant financial losses for both the parties. Also, the sources of risks and uncertainties in a project are more than a few.

The objective and expectation of building consumers and experts is to keep the final construction cost up to the planned budget or approved expenditure that include an added amount that caters for uncertainties and risk events which amounts to discrepancies. In construction, projects plan and cost estimates are usually worned out to ensure that the work is carried out to the preferred quality, within allowed time, and within planned budget. Unexpected actions in the execution of any building project are somehow predictable. The successful completion of any project is also assessed on the basis of three parameters such as time, money and performance which are the three types of contingencies. Cost contingency is included within budget estimation to represent the total financial assurance for the person who sponsors for the project. Therefore, the estimation of cost contingency and its ultimate adequacy is of critical importance to projects.

Contingency allotment has been the subject of various researches and similarly various methods of contingency calculation and allocation have been a concern. There is no project budget without a Contingency sum. One of the common methods of budgeting for contingency is by taking a percent of estimated cost based on previous experience with similar projects. Contingency may be derived either through statistical analysis of previous project cost undertaken or through the knowledge gained on similar projects.

To determine the contingency sum, first of all the factors that affecting cost and duration of various construction activities must be identified and analyzed to make an accurate contingency percent. Time and cost overruns have significant inference from an economic as well as political point of view. It is noted that the owners, consultants, and contractors do not give importance to evaluate the time and cost overruns at the end of project. Hence it is essential to identify actual causes of time and cost overruns to minimize and avoid delays and also increasing cost in any construction project,

This paper deliberated the factors affecting the duration and cost of the construction activity and presented the most probable factor from the collected data using SPSS and have also shown the neural network modeling for prediction of time and cost contingency values.

II. LITERATURE REVIEW

This literature survey is based on factors affecting construction duration and cost and their contingency estimation models which will be helpful in the modeling of time and cost contingency using soft computing techniques.

Ahmed M. G. Khalafallah, Mahmoud A. Taha and Moheeb El-Said (2014) developed a system for estimating cost contingencies during a tender preparation by conducting a survey relating to factors causing cost overrun using belief network. The developed system was tested using historical completed projects and its average error of estimating the cost contingencies was calculated to be 13.3%.

P. Vittal kumar (2013) found out the factors affecting construction duration activity where the top 10 factors obtained are Project Size, Project Location, Equipment Availability, Amount of interference, Change orders, Payment delays, Time to take decision, Productivity of labour, Weather condition, Soil condition. The study also formulated the time contingency value using Analytic Network Process (ANP) from Super Decision Software from which the average time contingency value is estimated as 36.78%

Shanmugapriya and Dr. K. Subramanian (2013) identified the factors influencing time and cost overruns in construction projects and evaluated their relative importance. This study determined the owners, consultants and contractor's perception towards the relative importance of key Time performance and Cost performance indicators in construction projects in order to evaluate their performance and formulated recommendations for improving time and cost performance.

Tarek Zayed, Dalia Mohamed, Florida Srour, Wael Tabra (2013) identified the factors that affect time contingency and developed a model that predicts time contingency index/value for construction projects using simulation based Analytic Hierarchy Process (AHP). The time contingency index (C) is defined as normal probability distribution with a mean value of 33.70% based upon the collected sample. The developed models are verified using seven case study projects, which show robust results in assessing time contingency index with average AVP value of 95.70%. This value demonstrates that the obtained results are fairly good and acceptable.

Zayed, T. (2009) developed a simple model that can be used in estimating the expected Time contingency of a construction project. The data obtained from a field survey were processed using Analytic Hierarchy Processes [AHP] to develop a time contingency model and found the average time contingency of the selected projects as 35.4%.

Gary.R (2006) identified 55 factors affecting the performance of the project schedule. They observed seven factors that have the most significant impact on the schedule outcome and divide them into two main categories. The first include factors that possess the capability to improve performance level, such as owner's competence as well as commitment and conflict among project members. The second include factors that tend to retain the schedule at its existing level, such as coordination among project members, lack of knowledge and skills for the project managers, hostile socioeconomic environment, and uncertainty of project members.

Ali Touran (2003) calculated the probability of cost overrun for a given contingency level and proposed a probabilistic model for the calculation of project cost contingency by considering the

expected number of changes and concluded that a contingency of 12 to 15% is adequate for the projects with 1 year estimated duration

III. RESERCH METHODOLOGY

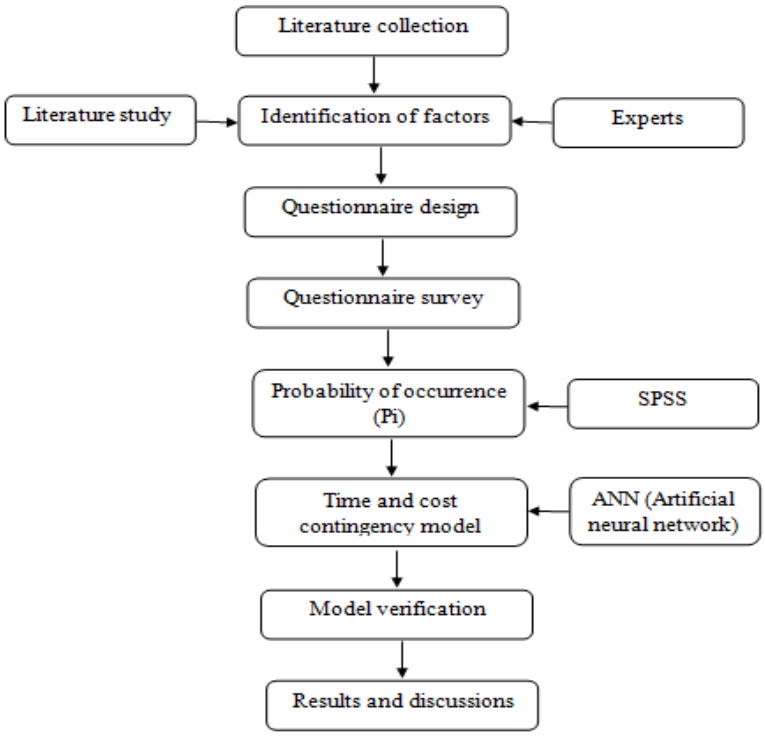

Figure 1. Research methodology

IV. QUESTIONNAIRE SURVEY, ANALYSIS & NETWORK MODELLING

4.1 Analysis of data

SPSS software (Social Package for Statistical Service) is used to find out the mean value and reliability analysis of the data's collected. The cronbach's alpha value has to be within 0.6 to1.0. Using Microsoft Excel, ranking of various factors influencing time and cost contingency in construction projects are calculated. Based on the ranking, the top most factors are identified

4.2 Reliability analysis

Prior to data analysis, the reliability of data was assessed using Cronbach's Coefficient Alpha Method, which is commonly used as an estimate of the reliability of data. Reliability scores obtained from responses of various companies indicate adequate internal consistency. The Cronbach's alpha obtained for respondents' data is given in the table below.

Table 1. Reliability analysis

Parameters	Cronbach's Alpha	N of Items
Time related factors	.754	30
Cost related factors	.646	30

Cronbach's alpha value is within the acceptable range. The value must be in the range of 0.6 to 1.0 if the data has to be reliable. Hence the data's values are reliable

4.3 Top most time and cost related factors

	Time related factors	Cost related factors
1.	Project Location	Poor site management and supervision
2.	Size of the project	Inadequate planning and scheduling
3.	High level of Change orders during construction	Lack of experience
4.	Bad Weather conditions at the project site	Inaccurate time and cost estimates
5.	Soil condition of the construction area	Inadequate monitoring and control
6.	Inadequate Change in Material Market rates	Cash flow and financial difficulties faced by contractors
7.	Delay in Payments by the owner to the contractor	Poor financial control on site
8.	Unavailability of labor	Financial difficulties of the owner
9.	Shortage of experienced staff and labors	Fluctuation of prices of materials during construction
10.	Lack of Experience in similar projects.	Inaccurate quantity take-off

Figure 2. Top factors

4.4 Neural network modelling for cost contingency

The top 7 factors are used as input for modelling the network. The cost data were obtained for the 20 construction projects and the obtained data set is been divided into training and test data. Model validation has been performed by comparing with several base estimates of various construction projects. Here 'y' represents cost contingency in %

Table 2. Cost training data set

S/No	x_1	x_2	x_3	x_4	x_5	x_6	x_7	y
1	1	1	2	1	1	2	2	5
2	3	1	2	3	3	2	4	0.3
3	2	1	1	1	2	2	2	2
4	2	1	2	3	3	2	4	6
5	3	1	1	1	2	2	4	3.8
6	4	1	2	3	3	2	5	4.2
7	2	2	4	3	3	3	4	2.6
8	3	2	5	3	3	3	3	5.2
9	4	2	5	3	3	3	4	3
10	2	1	2	3	3	2	4	0.6
11	3	1	1	1	2	2	4	0.3
12	2	1	1	1	2	2	2	4
13	2	1	2	3	3	2	4	2.5
14	3	1	1	1	2	2	4	1.2
15	4	1	2	3	3	2	5	3

Table 3. Cost testing data set

S.No	x_1	x_2	x_3	x_4	x_5	x_6	x_7
1	1	1	1	1	1	1	2
2	1	1	1	3	2	2	3
3	1	2	1	4	2	5	2
4	2	3	2	5	3	1	2
5	2	4	5	2	3	4	1

Table 4. Model validation for cost

S/No	ActualOutput	DesiredOutput	Difference(%)
1	5	5.2	0.2
2	6	6.1	0.1
3	3.5	4	0.5
4	4	3.6	0.4
5	5.8	5.1	0.7

4.5 Neural network modelling for time contingency

For modelling of time contingency, training and testing data sets were given as like cost modelling. Here, the training data is considered by taking the duration details of various construction projects. There were 7 top most factors have been taken as input for predicting the output for time contingency and the trained data has been tested and validated for conformance.

Table 5. Network architecture for time contingency modelling

Architecture	Properties
Input Neuron	7
Hidden Layer	3
Hidden Neuron	30
Output Neuron	1
Training Algorithm	Back Propagation
Learning Method	Trainlm
Number of Iterations	1000

Table 6. Testing dataset for time

S/NO	x_1	x_2	x_3	x_4	x_5	x_6	x_7
1	2	3	3	1	4	1	2
2	4	1	1	3	2	2	3
3	3	2	2	4	2	5	2
4	2	3	2	5	4	1	2
5	1	4	5	2	3	4	1

Table 7. Model validation for time

S/No	Actual Output	Desired Output	Difference (%)
1	18	17	1
2	22	21	1
3	14	11	3
4	16	13	3
5	9	8	1

V. CONCLUSION

This report presented the aim and objectives of the project for predicting the time and cost contingency based on the factors affecting time and cost of the construction projects. Various literatures have been studied with respect to the factors influencing time and cost contingency and the methods that have been used for assessing the contingency values. Questionnaire survey had been conducted for the scrutinized factors in order to grab the views of construction personnel's. Out of 120 questionnaires distributed, about 76 questionnaires were received which shows a response rate of 64%. Descriptive analysis of the questionnaire has been made using SPSS software from the response collected and the results were discussed. Finally, the top factors influencing the time and

cost contingency in construction projects are listed out had been assessed based on the mean score obtained from statistical analysis. The neural network modeling shows above 90% accuracy for the given training and testing data set. Hence, cost contingency is predicted as an average value of 5% and time contingency as an average of 20%.

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