

A Review on Application of Artificial Neural Networks for Predicting the Prices of Construction Materials

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Abstract - The price of some kinds of construction materials can change vastly in very short stages of time. The capability of a building contractor to exactly forecast upcoming construction material prices is critical for the success of ones' firm. Facts of upcoming material prices can give a builder more precise estimate of project cost. Artificial Neural Networks are ideal tools to help the contractor track the past prices and conditions affecting these prices and then predict the future prices. Various studies have illustrated the successful implementation of neural network models for such predictions. Researches are still continuing for developing more competent neural network models for material price prediction in the construction industry.

Key Words: Cost estimation, Material prices, Artificial Neural Network, Prediction

1. INTRODUCTION

The rate of construction materials is subjected to constant changes. The unexpected price changes affect the carrying-out rates of projects and even challenges the competence to finish the projects. The rapid and vast changes that occur all over the world in construction materials prices impacts the individual construction market value of each country. To avoid this problem, the contractor should have a tool or method that is capable to predict the future material prices. It is essential to predict the material prices variations during the implementation of the project as well as for preparing the tenders. Prediction of material price is an important function for effectively handling projects in terms of more exactly estimating, pursuing and monitoring projects. There are many tools which will help in the of development contractors by its ability to accurately predict the longer-term material prices. Some of the methods normally used for prediction of materials prices are Artificial Neural Network, Fuzzy Logic, and Statistical procedures (includes multivariate analysis, MONTE CARLO method, ANOVA), and Trend Analysis of which Artificial Neural Networks are the leading ones. Their ability to learn relationships that exist between a set of example independent input variables and a set of reliant output variables and easy training ability makes them compactible as an effective prediction tool.

2. REVIEW OF MODELS DEVELOPED USING ANN TO PREDICT CONSTRUCTION MATERIAL PRICES

Forecasting problems arise in various disciplines and therefore the literatures on forecasting using ANNs is scattered in numerous fields that it's hard for a researcher to be aware of all the work done so far within the area. The feature of ANN to forecast nonlinear time series with very high accuracy makes it employable in predicting the prices of construction commodities.

Ahmed Shiha et.al, (2019) has brought a light on the importance of cost estimation and how the variation of the material prices impacts the final budget of construction projects. The research proposed three models that utilize artificial neural networks (ANNs) to predict the forthcoming prices of major construction materials, namely cement and reinforcement steel bars 6 months ahead, in the context of the Egyptian construction industry. A Microsoft Excel spreadsheet that also utilizes genetic algorithm, Neural Tools software, and Python programming language in Spyder software were the platforms used to develop the three models. For this the ten-year data of steel and cement prices as well as macroeconomic indicators in Egypt were used for training, testing, and validation of the proposed models. The developed ANN models show promising results in prediction of month-to-month variations in material prices giving mean absolute-percentage error that ranges from 4.0% to 11% for the different models. It can be hence concluded that the proposed models can potentially be useful tools for construction contractors as well as owners for predicting and quantifying the fluctuations of major construction materials prices.

Issa R R (2015) conducted a study on Artificial Neural Networks (ANN) and concluded that they are the perfect tools to support the contractor track past prices, conditions affecting their prices and then forecast future prices. The ability of Neural Networks to learn the complex relationships that exist between a set of example independent input variables and a set of reliant on output variables makes them effective as prediction tools as well as the easiness to train them. In the research, the author recognized seven factors that having some possible result of the price of construction materials. They were analysed over a 10-year period to framing the lumber price. The author concludes that a

Neural Network can easily be trained to forecast the upcoming prices of construction commodities.

Mohamed Marzouk (2013) In this study a fuzzy logic model and Artificial neural network model was developed to calculate the degree of importance of each material in the item through the three main criteria namely, the percent of the elements share in the total cost items, the difference in the study of the elements price index during the study period and the difference percentage in the cost elements price respectively. A comparison was then made between Artificial Neural Network and Regression Analysis to analyse the efficiency of the models. The results showed that Neural Networks technique overtakes multivariate analysis with reference to the estimated mistake in expected increase of the project's basics cost.

Faiq Mohammed Sarhan (2012) In this study, Multi-layer perceptron utilising the back-propagation algorithm was formulated for estimating of the production of construction projects. It was found that ANNs have the power to forecast the productivity for finishing works with a really good degree of accuracy of the factor of correlation was 89.55% and average precision percentage of 90.9%. The back propagation neural network model used in this work has proven to be very successful in modelling nonlinear relationships. Therefore, ANNs are often used rather than numerical programs to point out the nonlinear function for any problem.

Pewdum (2009) developed neural network models to forecast the ultimate budget and time-period of a highway construction project at its initial stage. Factors affecting final budget and duration were presented in the study. The forecasting results obtained from the proposed method based on ANN application were more reliable than those obtained from the method based on the earned value which was used previously. The author gave implications to develop much more accurate ANN models to forecast the final budget and duration of highway construction projects during the construction stage by using project data reflecting continual and seasonal cycle data.

Sang C. Lhee et.al (2012) stated that the final budget of construction works tops the initial budget and can often cause project delays, disputes and, effects the quality of work as well. This makes the cost contingency an important factor to be considered and evaluated rather than keeping a fixed percentage of the total cost of project for this. The researchers found out those factors influencing this contingency and proposed a new method for predicting the owner's financial contingency on transportation construction projects using an Artificial Neural Network based method. The data of Asphalt resurfacing works among transportation projects rendered by the Florida Department of Transportation (FDOT) completed from 2004–2006 were used for this study. The results showed the feasibility of the

ANN approach in the prediction of contingency. Accurate predictions of contingencies using this approach aid the project administrators for the better management of contingency requirements on financing projects.

Hegazy (1998) developed an artificial neural network for estimating the cost of highway projects using the past 5-year data of 18 projects. Simple optimization, genetic algorithm and backpropagation analysis were done initially to find the optimum weight of each connection in the network to get the most accurate model. The developed model was provided with a module to study the sensitivity of the project to the changes in cost related parameters so as to study its significance and to deal with real-world problems. An additional module was also given for new users as an interface to input their estimation problems and convert the model suitable to his/her environment.

Margaret W. Emsley et.al, (2002) attempted to predict the final cost of construction projects with the aid of Artificial Neural Networks with the data collected from about 300 real-life construction projects. The major data included the final account sum of projects with which the model was developed and evaluated against a linear regression technique. The best model developed in the research gave the mean absolute percentage error as 16.6% which proves to the better than the error between 20.8% and 27.9% obtained when using traditional prediction methods.

3. CONCLUSIONS

Fluctuations in the prices of construction materials with time have a significant impact on the overall cost of construction projects. Prediction of material prices can have a greater benefit to the contractor over their competitors when it comes to competing for projects. Of the many methods available which serve the function as prediction tools, studies show that an Artificial Neural Network is an effective tool to model the non-linear relationship that exists between the variables under study. The development of such a system will surely aid in the effective completion of the project on time and under the budget. It can also interest investors to capitalize in this construction sector which will ultimately lead to the growth of the industry.

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