

# Models for Predicting Material Price in Construction Project

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**Abstract:** *Changes in construction materials' prices have a great impact on the cost of construction projects. Such fluctuations in prices occur erratically at changed rates over time. There is no clear relationship that can be used to provide accurate calculations of materials' prices. One of the biggest problems that face the construction contracts is unbalanced rights and obligations between owners and contractors. It is necessary to have a system that is capable to estimate the size and amount of the change in materials' prices at reasonable accuracy. There is also a need to predict the change in building materials' prices during the execution phase of the project as well as during the preparation of tenders. Thus, determination of the appropriate lead time to order needed building materials to execute various activities could be done. This research proposes a methodology for to predict the aluminium material price using artificial neural network, trend analysis and SPSS analysis. The analysis was done and hence it proved that the artificial neural network analysis is better than other analysis.*

**Keywords:** Aluminium price prediction, Artificial Neural Network, Trend Analysis, SPSS

## 1. Introduction

The construction industry is the second largest industry of the country after agriculture. It makes a significant contribution to the national economy and provides employment to large number of people. The use of various new technologies and deployment of project management strategies has made it possible to undertake projects of mega scale. In its path of advancement, the industry has to overcome a number of challenges. However, the industry is still faced with some major challenges, including housing, disaster resistant construction, water management and mass transportation. There are numerous challenges facing today's construction manager. Some are new to the industry, and some are centuries old.

Many of these challenges are a direct result of construction operations, while others a result of indirect, peripheral activities. Construction projects represent a unique set of activities that must take place to produce a unique product. The success of a project is judged by meeting the criteria of cost, time, safety, resource allocation, and quality as determined by the owner. Cost Estimation from Client's perspective is essential to know the expected project cost for allocation of the budget and the feasibility of any project. On the other hand, the Contractor's undertakes the cost estimate practice basically for the tendering purpose in order to get the project with good profit margin.

Usually, the Client provides the bill of quantities for tendering purpose, which has been prepared by the Project Consultant. However, on receipt of the tender whole documents, it is the Contractor's Estimator's responsibility to cross check all quantities with contract drawings and specification. It is very common practice that Contractor's Estimator always finds ambiguity in the BOQ (Brook, 2008).

Since construction material price is very important in estimating the budget of a construction project. It is very complex to estimating a budget for a upcoming project in

an accurate manner because the fluctuations will be arised in the material price. Sometimes the changes in the construction material price may leads to profit to the contractor or leads loss to the contractor. Changes in the price of construction material price may have a great impact on construction project cost by over run the price of construction materials is not stable /same all the time it changes in very short periods of time. Due to this the contractor could not able to predict the future construction prices and construction project cost due to this there will be obligation occurs between the owners and the contractors. In order to avoid that there is a need of a system that is capable to predict the size and of change in materials prices at on acceptable accuracy. And it is needed to predict the material prices changes during the execution of the project and also for preparing the tenders. And it also enables the serious competition among the various contractors.

Forecasting of material price is an important function for effectively managing projects in terms of more accurately estimating, tracking and controlling projects. There are many tools that can be help the construction contractors by its ability to accurately predict the future price of the materials. Some of the methods normally used for prediction of materials prices are Artificial Neural Network, Fuzzy Logic, and Statistical Method (includes Regression Analysis, MONTE CARLO method, ANOVA), Trend Analysis. The analysis introduced here in is limited to the prices of some materials in the period from 2000 to 2015. These selected time periods can be divided into stable economic period from 2000 to 2010 and growth economic period from 2011 to 2015. The analysis was differentiated by the status of the economy. The following sections discuss international prediction material prices, forecasting with various prediction tools, data collections and analyses, validation of results and finally conclusion and recommendations.

## 2. Objective of the Study

- To identify the tools which are used for the prediction of material prices in construction.
- To evaluate the viability of using various material price predicting models.
- To make a result on model in predicting material price with better accuracy and viability.

## 3. Scope of the Study

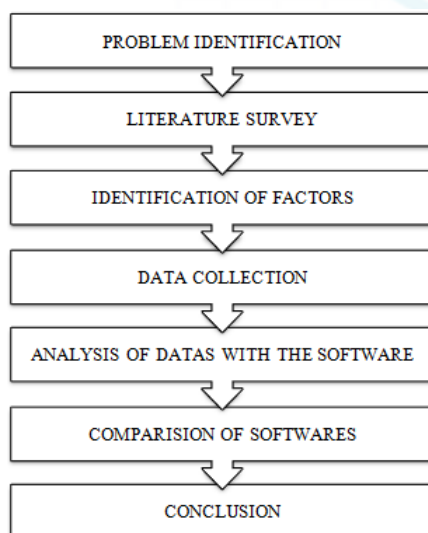
- This study is limited to predict the aluminium material price, specifically in the country of India.
- Factors affecting the price of aluminium material were considered in the study.

## 4. Methodology

The objective of the project was to predict the aluminium material price in construction projects. To achieve this objective the following methodology were adopted. The methodology involves collection of the factors affecting aluminium price in construction projects. The identified factors were listed and compared with various prediction tools to achieve prediction with better accuracy.

The procedure followed in this study is as follows,

- To identify the importance of materials, and to identify how influence in the cost of projects.
- Collect and inspect the documented information of aluminium costs
- Distinguish the most well-known affecting components
- Identify the sections of every cost thing,
- Select the rate like correlation of every section in the cost of the cost thing,
- Apply Trend analyse to predict future prices.
- Apply SPSS analyse to predict future prices
- Apply Artificial Neural Network to predict the future prices
- Compare the best tools among the over three.



**Figure 1:** Flow chart illustrating methodology for models for predicting material price in construction project

## Artificial Neural Network

Artificial Neural Network is a predicting tool that has the ability to predict the future price of materials accurately. Artificial Neural Network is a nonlinear model that is easy to use and understand when compared with statistical methods. It is non-parametric model while statistical methods are parametric model that need higher background of statistic. ANN with Back propagation learning algorithm is widely used in forecasting problems. Even though Back Propagation convergence is slow but it is guaranteed with better accuracy. But, Artificial Neural Network cannot interpret relationship between input and output and cannot deal with uncertainties.

Artificial neural networks (ANNs) are systems that can learn. A neural system can be trained on a set of input and output data belonging to a particular problem. If new data of the same problem, but not in the training set, are presented to the system, the ANN can use the learned data to predict outcomes without any specific programming relating to the category of events involved. The fields of application of ANNs have increased dramatically in the past few years. A large variety of possible ANN applications now exist for non-computer specialists. Therefore, with only a very modest knowledge of the theory behind ANNs, it is possible to tackle complicated problems in a researcher's own area of speciality with the ANN technique.

## Trend Analysis

Trend Analysis is a mathematical technique that uses historical records of results and data to predict future outcome. The predicted outcome is achieved by tracking variances in cost and schedule performance. Applications for trend analysis seem almost limitless as there is availability of data is large in virtually every field and the ability of computer to process it. This method can be replicated, checked, updated and refined when necessary. A trend analysis is an aspect of technical analysis that tries to predict the future movement of a stock based on past data. Trend analysis is based on the idea that what has happened in the past gives traders an idea of what will happen in the future.

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## SPSS Analysis

SPSS (Statistical Package for the Social Science) is the most popular statistical packages which are used for predicting future results by performing highly complex data manipulation and analysis with simple instruct. It offers complete plotting, reporting and presentation features. Its menu offerings are typically the most basic of

an analysis and sometimes lacking even then, and it makes doing an inappropriate analysis very easy.

SPSS can take data from almost any type of file and use them to generate tabulated reports, charts, and plots of distributions and trends, descriptive statistics, and conduct complex statistical analyses.

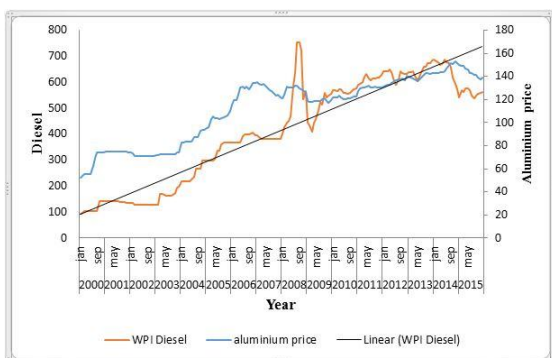
SPSS is developed by Norman H. Nie and C. Hadlai Hull of IBM Corporation In the year 1968. It is compatible with windows, Linux, UNIX and Mac operating systems. SPSS is among the most widely used programs for statistical analysis in social science.

SPSS offers a user friendliness that most packages are only now catching up to. It is popular and though that is certainly not a reason for choosing a statistical package, many data sets are easily loaded into it and other programs can easily import SPSS files. For academic use SPSS lags notably behind SAS, R and even perhaps others that are on the more mathematical rather than statistical side for modern data analysis. Its menu offerings are typically the most basic of an analysis and sometimes lacking even then, and it makes doing an inappropriate analysis very easy. It is expensive, sometimes ridiculously so and even when you do buy really only leasing, and its license is definitely not user friendly.

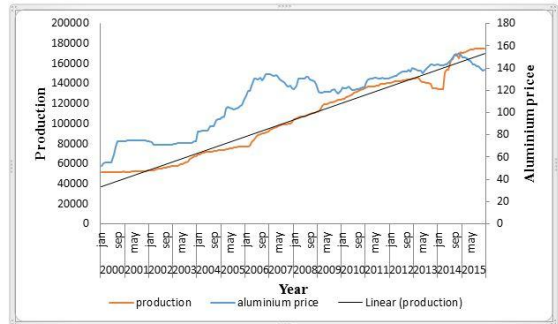
**Data Analysis**

The data of aluminium price and the identified influencing factors was collected from the period of 2000 to 2015. From the collected data the coefficient of correlation is estimated between the cement prices and identified influencing factors. The Linear relation can be measured by these coefficients.

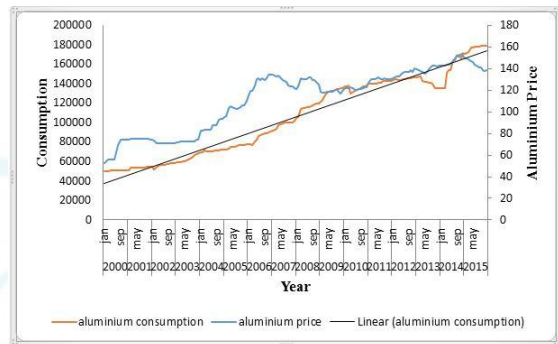
Fig 1 represents between the correlation of aluminium price and diesel price ( $R^2 = 0.92$ )  
 Fig 2 represents between the correlation of aluminium price and production ( $R^2 = 0.90$ )  
 Fig 3 represents between the correlation of aluminium price and consumption aluminium ( $R^2 = 0.89$ )  
 Fig 4 represents between the correlation of aluminium price and electricity demand ( $R^2 = 0.82$ )  
 Fig 5 represents between the correlation of aluminium price and excise duty ( $R^2 = 0.82$ )  
 Graph trending gives the result of increase trend Ref. Fig 1, Fig 2, Fig 3, Fig 4, Fig 5.



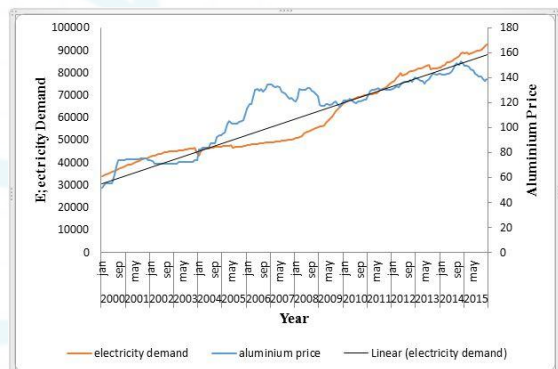
**Figure 1** Correlation between aluminium price and diesel price



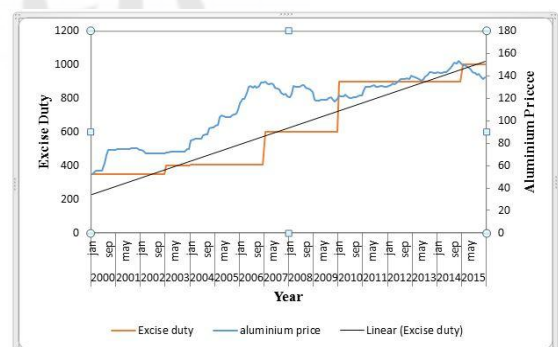
**Figure 2** Correlation between aluminium price and production



**Figure 3** Correlation between aluminium price and aluminium consumption



**Figure 4** Correlation between aluminium price and electricity demand



**Figure 5** Correlation between aluminium price and excise duty

**Artificial Neural Network Forecasting model**

The input variables can take for this forecasting function as diesel price, production, aluminium consumption, electricity demand, excise duty as followed by the years of 2000 to 2015 is proposed. Training data was chosen 80%



and testing sizes 20% and it can be made further activation functions and changing the input neuron weights. The prescribed data which that can be normalized identified value and it is done with the range of 0 to 1 and it to be de-normalized into forecasted result. Before the selected input variable the value should be output aluminium price will be coincide into different selected input variables and minimum value of correlation coefficient phenomena is taken as better input for the model from selected.

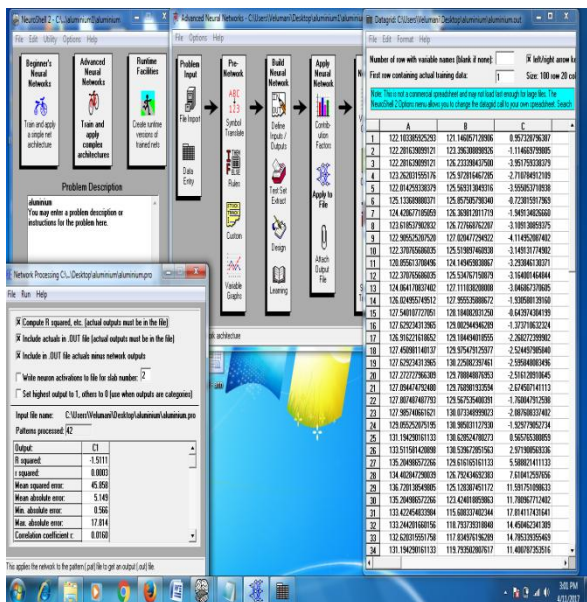


Figure 6 Aluminium Data Analysis using ANN

### 5. Trend Analysis

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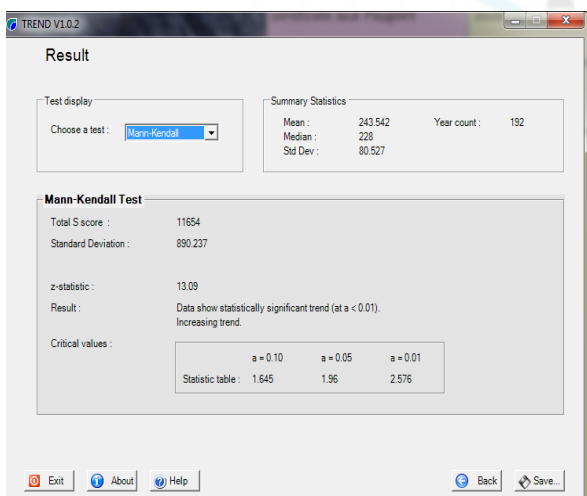


Figure 7 Aluminium Data Analysis using Trend Analysis

### SPSS Analysis

In multiple regression investigation, an attempt is made to signify the variation of the independent factors in the significant variable synchronically. Multiple regression analysis models are framed as in the following,

$$y = ax_1 + bx_2 + cx_3 + dx_4 + fx_5 + e$$

where,  $x_1$  - Production,  $x_2$  - diesel,  $x_3$  -consumption,  $x_4$  - electricity demand.

$a = 2.143$ ,  $b = 0.354$ ,  $c = 0.065$ ,  $d = -0.257$ ,  $f = 2.195$ ,  $e$  - error = 61.408

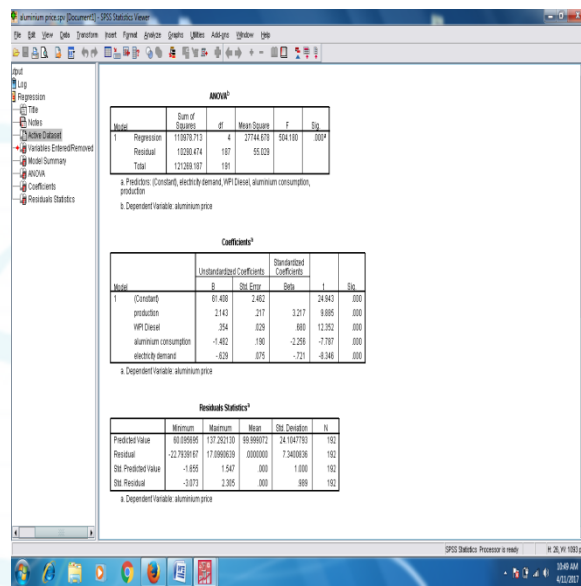


Figure 8 Aluminium Data Analysis using SPSS Analysis

### 6. Results and Discussion

The performance of Artificial Neural Network, SPSS (Regression analysis) and Trend analysis was compared. The results exposed that artificial neural network analysis gives better accuracy in result than regression analysis, trend analysis of aluminium price. The refined elements of restoration results for Regression analysis, Trend analysis and ANN with least MAPE and correlation amongst real and predicted aluminium price are given in Table 1.

Table 1: Predicted value (MAPE) – Average against of Actual Value

| Regression analysis | Trend Analysis (Increase/Positive trend) | ANN |
|---------------------|--|-----|
| 4.2                 | 5.8                                      | 2.6 |

### 7. Conclusion

The accurate estimation of aluminium material price is an essential practice, especially in developing countries where high price fluctuations can negatively affect projects success and even viability. Factors affecting aluminium price have been related in previous literatures to cost of the production process, raw material prices, consumption of

aluminium, excise duty, electricity price and electricity demand and industry related factors. The result exposed that ANN technique gives better accuracy than Trend analysis and SPSS analysis. Artificial neural network is a excellent tool that can be used to make accurate prediction.

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