



ISSN 2278 – 0211 (Online)

Analysis of Construction Dispute Resolution Process Using Artificial Neural Networks

Asra Fatima

Research Scholar, GITAM University, Hyderabad
Assistant Professor, Department of Civil Engineering
Muffakham Jah College of Engineering & Technology, Banjara Hills, Hyderabad, India

Dr. T. Seshadri Sekhar

Project Guide, Professor & HOD, Department of Civil Engineering
GITAM University, Hyderabad Campus, Hyderabad, India

S. M. Abdul Mannan Hussain

Research Scholar, GITAM University, Hyderabad
Assistant Professor, Department of Civil Engineering
Malla Reddy Engineering College (Autonomous), Maisammaguda, Secunderabad, India

Abstract:

The costs associated with resolving disputes are often high, and the time involved can be very long. Disputes are a common occurrence within the construction industry. Construction disputes, when not resolved in a timely manner, become very expensive in terms of finances, personnel, time, and opportunity costs. The visible expenses such as attorneys, expert witnesses, the dispute resolution process itself alone are significant. The less visible costs like company resources assigned to the dispute, lost business opportunities and the intangible cost that damages the business relationships, potential value lost due to inefficient dispute resolution. The aim of the study is to identify the qualitative parameter and develop an Artificial Neural Network model to minimize the construction dispute resolution and reduce the cost of the project by optimizing the parameters.

The methodology has been incorporated into a computer module, which integrates the concept of Artificial Neural Network (ANN) with the current estimating system. A new approach to dispute resolution methodology is presented which optimizes the frequently occurring dispute parameter which in turn reduced the cost of the project with the aid of artificial neural networks. The methodology allows solute transport simulations, usually the main computational component of management models, to be run in parallel. The ANN techniques inspired by neurobiological theories of massive interconnection and parallelism, has been successfully applied to a variety of optimization problems.

Keywords: Artificial Neural Network, Neural Network, Alternate Dispute Resolution, Dispute Review Board

1. Introduction

The Construction industry is dynamic and competitive environment. Relationship within construction, between clients, contractors, sub-contractors and suppliers, are often adversarial. The risks associated with construction projects can be high, the process is complex and obligations are often onerous. Dispute resolution in the construction industry has been topical because of the growing concern over the ever increase in management resources to deal with construction disputes. Innovative dispute resolution processes, generically described as alternative dispute resolution, have been developed and introduced to facilitate amicable resolution. ADR is a non adversarial technique which is aimed at resolving disputes without resorting to the traditional forms of either litigation or arbitration. The use of Artificial Neural Network (ANN) in dispute resolution is extending this trend at the double, by contributing to a more efficient use of ADR methods. The success or otherwise of a resolution process depends on a wide range of factors. Ellis and Baiden (2008) state that disputes between project participants have been identified as the principal causes of poor performance in construction projects and that disputes very often lead to prolonged delays in implementation, interruptions and sometimes suspensions.

2. Necessity of the Study

The Construction industry is dynamic and competitive environment. Relationship within construction, between clients, contractors, sub-contractors and suppliers, are often adversarial. The risks associated with construction projects can be high, the process is complex and obligations are often onerous. The way demand is put on the industry through competitive tendering procedures can often increase adversity. It is often said that in such commercial atmosphere conflict is inevitable; indeed conflict is a necessary part of the competition of commercialism.

Disputes are a common occurrence within the construction industry. The costs associated with resolving disputes are often high, and the time involved can be very long. Construction disputes, when not resolved in a timely manner, become very expensive in terms of finances, personnel, time, and opportunity costs. The visible expenses (e.g., attorneys, expert witnesses, the dispute resolution process itself) alone are significant. The less visible costs (e.g., company resources assigned to the dispute, lost business opportunities) and the intangible costs (e.g., damage to business relationships, potential value lost due to inefficient dispute resolution) are also considerable, although difficult or impossible to quantify.

3. Alternate Dispute Resolution

The term "Alternative Dispute Resolution (ADR)" is generally understood to refer to any type of procedure that constitutes an alternative to litigation (and arbitration) for the resolution of disputes. These resolutions normally are assisted by a neutral third party who helps to facilitate such a resolution. In contrast to litigation and arbitration, ADR techniques are not intended to lead to a binding and enforceable determination of a dispute.

3.1 General Features

Although a great variety of ADR techniques exist, but there are have certain general features for dispute settlement in common are the parties voluntarily agree to participate in the proceeding. They decide which kind of ADR technique is to be used, which if any rules of procedure should be valid and whom to nominate as neutral third party. This principle of party-autonomy and flexibility implies the party's freedom to submit voluntarily the dispute to a binding determination of the third party and to choose independently the applicable rules of law (if any) and the remedies. The parties therefore have a kind of "ownership" of the proceeding, the main reason why parties tend towards the alternative approaches. Due to this autonomy, a high degree of satisfaction can be reached and the parties are likely to settle their disputes amicably.

3.2 Development

Although some of the alternative methods of dispute resolution existed from the beginning of mankind, e.g. resolutions by negotiation and mediation, the techniques of ADR today have its origins in the early nineteen seventies. Members of the civil rights movement of the nineteen sixties in the United States and people influenced by it had new ideals of dispute resolution; disputes should not be solved by public courts, but under the premises of direct responsibility, autonomy and solidarity. In order to resolve disputes in private, so called "Communities" or "Neighbourhood Justice Centers" were founded, with the main focus on mediation of disputes arising out of crimes. These Centers should provide a variety of dispute resolutions reaching from negotiation over mediation to adjudication. This lecture seems to have been a striking success, since just a couple of months later the American Bar Association established a Special Committee on Minor Disputes.

3.3 Techniques of Alternate Dispute Resolution

If the parties agree to settle their dispute by an alternative approach instead of adjudication, they have to decide which kind of alternative technique deems to be appropriate. In the following, these techniques are classified in broad terms only and they can vary in detail or in their application depending on the ADR practice in different cultures. However, these techniques can be classified according to their intensity and formality in three broad categories:

- Negotiation
- Mediation
- Adjudication

Negotiation is the less intense method to resolve a dispute and the method most likely to lead to an amicable solution, whilst adjudication has a very direct and intense result to the parties, with a binding judgment and strict rules of procedure. Mediation is a form of a structured negotiation between the parties utilizing the services of an outside neutral facilitator. The role of the mediator is generally to help bring the parties closer together in terms of persuasion until agreement on the reached solution.

3.4. Dispute Resolution Using Artificial Neural Networks

A neural network is an adaptable system that can learn relationships through repeated presentation of data and is capable of generalizing to new, previously unseen data. Neural networks are used for both regression and classification. In regression, the outputs represent some desired, continuously valued transformation of the input patterns. In classification, the objective is to assign the input patterns to one of several categories or classes, usually represented by outputs restricted to lie in the range from 0 to 1, so that they represent the probability of class membership. NeuroSolutions, neural network package pattern classification by Multi-Layer Perception (MLP) provided such a feature and was accordingly selected for the investigation. For classification, MLP can learn the Bayesian posterior probability of correct classification; thus, the neural network takes the relative frequency of occurrence of the

classes into account, giving more weight to frequently occurring classes. Generally speaking, for static pattern classification, the MLP with two hidden layers classifies universal patterns whereby the discriminate functions can take any shape, as required by the input data clusters. Moreover, when weights are properly normalized and the output classes are normalized 0/1.

4. Model Development

4.1. General

The methodology employed in the study is Artificial Neural Networks. An artificial neural network is a collection of connected models neurons. Taken one at a time each neuron is rather simple. As a collection however, a group of neurons is capable of producing complex results. A neural network is simply a collection of neuron layers where the output of each previous layer becomes the input to the next layer. So, for example, the inputs to layer two are the outputs of layer one. In this exercise we are keeping it relatively simple by not having feedback i.e. output from layer "n" being input for some previous layer.

4.2. Neural Networks and Standard Statistical Methodology

Indeed, neural networks have been categorized as a form of nonlinear regression. It has also been observed that multiple linear regressions, a standard statistical tool, can be expressed in terms of a simple ANN node. For example, given the linear equation $y = a_0 + b_1x_1 + \dots + n_nx_n$, the x_i can be taken as the inputs to a node, the m_i taken as the corresponding weights, and n_0 taken as the activation function.

Rank	Algorithm Type		
	Statistical	Neural Network	Machine Learning
1	15	1	6
2	7	8	7
3	11	4	7
4	10	5	7
5	6	8	8

Table 1: Classification algorithm types ranked for different data sets by error rate

4.3. Artificial Neural Network model

An artificial neural network is a collection of connected models neurons. Taken one at a time each neuron is rather simple. As a collection however, a group of neurons is capable of producing complex results. In the following sections briefly a mathematical model of a neuron, neuron layer, and neural network is summarize before discussing the types of behavior achievable from a neural network. Neural network technology mimics the brain's own problem solving process. Just as humans apply knowledge gained from past experience to new problems or situations, a neural network takes previously solved examples to build a system of "neurons" that makes new decisions, classifications, and forecasts. Neural networks excel at problem diagnosis, decision making, prediction, classification, and other problems where pattern recognition is important and precise computational answers are not required The inputs are fed into the input layer and get multiplied by interconnection weights as they are passed from the input layer to the first hidden layer. Within the first hidden layer, they get summed then processed by a nonlinear function (usually the hyperbolic tangent). As the processed data leaves the first hidden layer, again it gets multiplied by interconnection weights, then summed and processed by the second hidden layer. Finally the data is multiplied by interconnection weights then processed one last time within the output layer to produce the neural network output.

The MLP and many other neural networks learn using an algorithm called back propagation. With back propagation, the input data is repeatedly presented to the neural network. With each presentation the output of the neural network is compared to the desired output and an error is computed. This error is then fed back (back propagated) to the neural network and used to adjust the weights such that the error decreases with each iteration and the neural model gets closer and closer to producing the desired output. This process is known as "training".

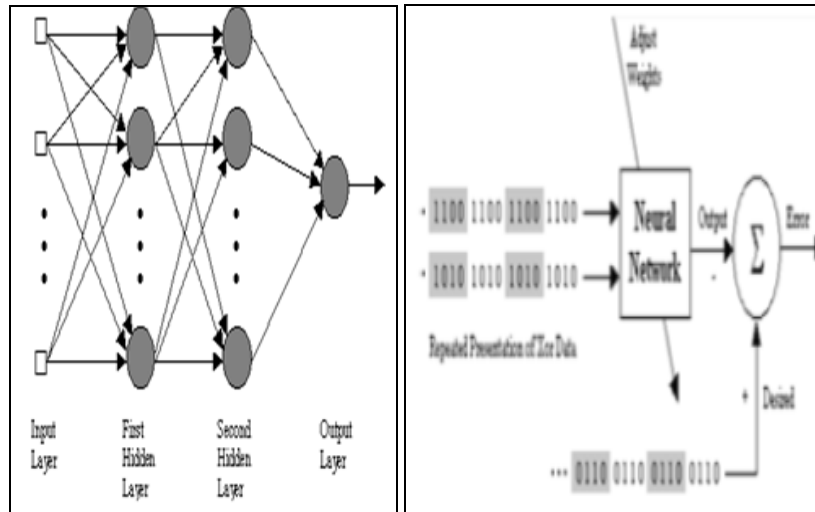


Figure 1: Block diagram of a two hidden layer multilayer perceptron

Figure 2: Learning of a neural network model

5. Results and Conclusion

Based on the on the present case study the following results are determined. The various factors are tabulated as follows which indicate the data representation to achieve the following results.

- The following are the costs obtained from the table are as follows:
- The Total Cost of Construction = Rs. 6, 62, 76,880
- The Actual Cost that had incurred due to Dispute = Rs. 66, 27,688
- Total percentage decrease in Actual Cost of project = Rs. 48.22
- Total decrease in Total Cost of project = Rs. 31, 96,487
- Total percentage decrease in Total Construction Cost of project = 4.82 (i.e., 3196487/66276880*100)

Factors	Data	Remarks
Project Year	Binary	Grouped:2010-2014
Project month	Binary	Monthly distribution
Project location	Binary	NW, NE, SW, SE sectors
Project Duration	Binary	monthly analysis
Project Estimate Dates	Binary	Early/Late estimate
Project Status	Binary	In time / Delayed (option for Forecasting, costs in case of delay).
Labor Estimate	Raw	Crew size, additional requirement etc.
Equipment Estimate	Raw	Hired machinery and additional requirement
Material Estimate	Raw	Monthly distribution
Other Estimates	Binary	
Other Factors	Binary	Site conditions, change orders

Human Factor	Binary	Manual Estimates
Average Mean Temperature	Binary	Degrees

Table 2: Neural Network factors and their data type

Factors	Actual Costs	Predicted Costs	Differences
Tender price index	349602	399384	-49782
Inflation	331576	399384	-67808
Design Complexity	408002	399384	8618
Interest	384178	346966	37212
Construction Complexity	427589	346966	80623
Work scope definition	315177	399384	-84207
Design Changes	477233	346966	130267
ADR Cost	185811	363100	-177289
Selection criteria	3748520	429667	3318853
Total	6627688	3431201	3196487

Table 3: The Difference in actual and predicted costs for each dispute parameter

- From the above results there is a saving of Rs. 31, 96, 487 for the total project. The amount saved by using neural network approach is 4.82 % of the total construction cost. If this model would have been used in the initial stages of construction there would be a total saving of Rs.31, 96, 487.

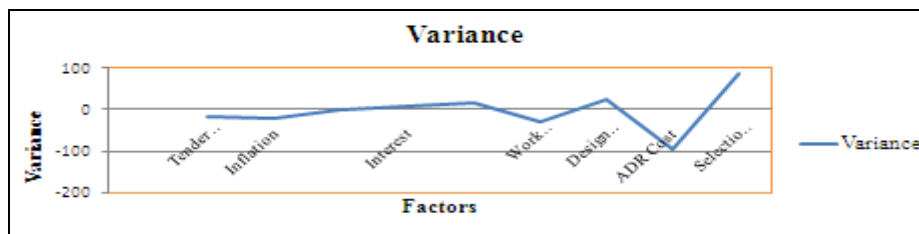


Figure 3: Variation of costs for the dispute parameters

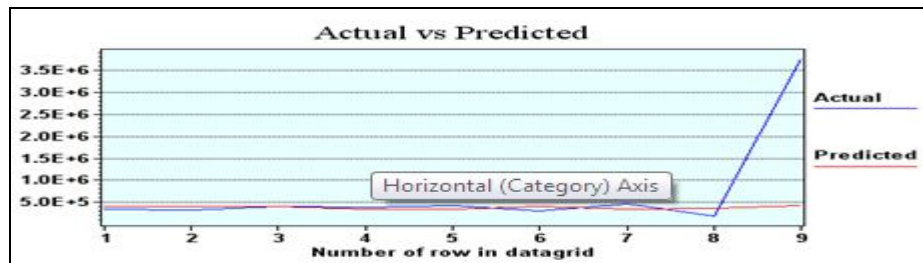


Figure 4: Actual Vs Predicted values

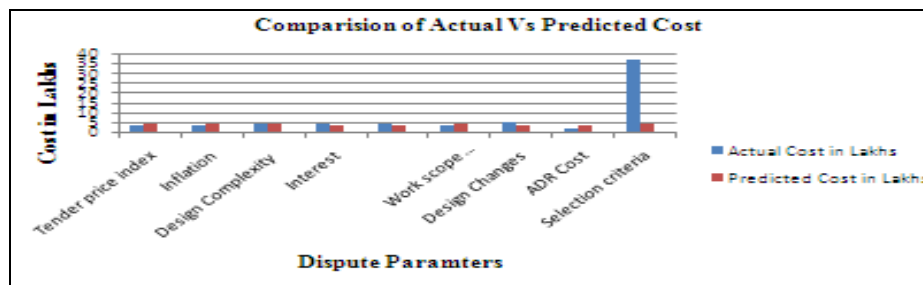


Figure 5: Comparison of actual and predicted costs

6. Summary and Conclusion

This study demonstrates the benefits of ANN technique used for dispute resolution process. The ANN model has been developed for resolving the dispute and analyzing it based on the factors gives a good justification rather than theoretical conclusions. It is recognized that the results obtained from the developed model, is as good as the quality of the data input which is based on dispute factors. The results obtained from the neural network model are well compared with actual values. This indicates that a developed neural network model offers a viable alternative for optimization the parameters. The developed model is more accurate and simple to use, with much time saving compared to elementals and other

7. Scope of Future Work

Disputes are a common occurrence within the construction industry. The costs associated with resolving disputes are often high, and the time involved can be very long. And so resolution of dispute plays a vital role. Further scope of work can be done by using ADR for dispute resolution by Fuzzy Logic (FL), Case Based Reasoning (CBR), and Genetic Algorithm (GA) for optimizing the cost and duration of the project

8. References

1. Anderson, M., and Rosenfeld, J., (1987), "Fuzzy Logic and Neural Network Handbook", McGraw-Hill, Inc., New York, USA, 227-231.
2. Anwar, M. Omar (2007) "Delay claim management in constructions" Govt. Project management's magazine, Dubai.
3. Brown, O.Ruchti, T., and Feng, T., (1993), "Construction Resource Scheduling with neural networks and Genetic Algorithms." J. Constr. Engrg .and Mgmt., Vol.122 (2), 125-132.
4. Cheung, S.O, and Laun, T. I (2002)"Fundamentals of the alternative dispute resolution process in construction. " J. Constr .Engrg. and Mgmt, ASCE,128(5) 409-417.
5. Calvin, B., Ruchti, H., and Feng, M. (1993), "Resource Scheduling with neural networks and Genetic Algorithms", J. Constr. Engrg. and Mgmt, Vol.122(2),125-132.
6. Henry, P., (1985), "Optimization of Resource Allocation and Leveling Using Genetic Algorithms", J. Constr. Engrg. and Mgmt, Vol.125(2) ,167-175.
7. John Rumel.H and Mc Clelland (1986), "Fuzzy Logic and Neural Network Handbook", McGraw-Hill, Inc., New York, USA, 227-231.
8. McCulloch and Pitts (1943), "Fuzzy Logic and Neural Network Handbook", McGraw-Hill, Inc., New York, USA, 221-235
9. Pao. Jo (1989), "Resource Optimization of Linear regression model using Neural Networks", J. Constr. Engrg. and Mgmt, Vol.129(3), 136-144.
10. Rosenblatt, B., (1958), "Neural Networks for Financial Forecasting Hand book", McGraw-Hill, Inc., New York, USA, 235-239.
11. Ruchti. H., and Feng. M., (1993), "Neural Networks for Financial Forecasting Hand book", McGraw-Hill, Inc., New York, USA , 231-236