

# Chapter 28

## A Neural Network Model for Predicting Cost of Pre-Fabricated Housing

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### ABSTRACT

*Low performance of the construction industry stresses the need for improving current practices - especially in regard to cost. In this study the authors have found a critical set of variables for predicting total cost of pre-fabricated housing. A neural network model was applied on more than 30 projects. The model relies on 17 critical cost prediction variables. Verification, on 28 buildings, showed that: 85.7% of predicted values had the deviation lower 5%, while 10.7% had the deviation lower than 10%, in relation to the actual cost. After validating the model on new data the performances were as follows: 83.8% of predicted values had the deviation lower 5%, while 12.9% had the deviation lower than 10%. Thus, using this model, construction companies can influence project performance during project early phases, and acquire more competitive position on the market.*

### INTRODUCTION

Since construction industry has a poor project management performance, especially in relation to achieving cost objectives (Al-Jibouri, 2003; Atkinson, 1999; Costa, Formoso, Kagioglou, & Alarcón, 2004; Roztocki & Weistroffer, 2005),

construction companies have to be more accurate in predicting total cost of building, still during the tendering phase. Thus nowadays only 34% of projects make it on the time, within the budget and in accordance with the agreed scope (Standish-group, 2009; Vukomanović, Radujković, & Burcar Dunović, 2008). Because of this bad performance

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the construction has been proclaimed the worst, inefficient, plundering etc (Beatham, Anumba, Thorpe, & Hedges, 2004, 2005).

Neural networks (NN) are a form of artificial intelligence which tries to simulate behavior of human brain. The first model was published in 1943 by McCulloch and Pitts (McCulloch & Pitts, 1943), where the authors analyzed fundamental logic functions. Besides the founders; Hebb (1949), Lashley (1951), Minsky (1988) and many others served as the catalyst of change and as promoters of NNs. After initial fame, up to 1980s and the IT dawn, NN were developing in a slower pace, considering only smaller improvement (Kohonen, 1988; Rumelhart & McClelland, 1982; Werbos, 1994). Rapid development of IT stimulated further development of NN, as well.

Nowadays, NN can be also found in researches in area of construction management. E.g., Chua et al. (Chua, Loh, Kog, & Jaselskis, 1997) studied the influence of critical success factors on planned construction cost. Ling et al. (2004) defined a set of indicators that can predict project performance in Design & Build projects. They found strong correlation among 65 success factors and 11 criteria of project success. Odeh et al. (2002) studied a set of indicators in correlation with project time, in traditional, construction management procurement routes. Kog et al. (Kog, Chua, Loh, & Jaselskis, 1999) designed a model using NN in predicting the deviation [%] of project time. Iyer et al. (2005) and Iyer and Jha (2006) analyzed more than 1500 projects in India and found reliable set of factors for prediction of cost in traditional building projects. NN can be also found in many areas besides construction, e.g.: finance, ICT, medicine, transport etc, as well.

While competitive pressures are forcing construction contractors companies to produce numerous bids every day (Al-Jibouri, 2003; Iyer & Jha, 2005; Radujkovic, 1999), investors (sponsors) do not have any obligation to even consider them. This huge gap between realized

and unrealized bids has unfortunately become a common practice, especially in pre-fabricated housing. This only indicates low ability of the companies in calculating the final cost. Therefore we sought to find a solution to this problem using NN approach.

This paper elaborates the potential of NN on pre-fabricated housing. It examines and identifies variables for predicting final cost of building. It proposes a NN model for cost prediction, which companies can, during early project phases; use to calculate relatively accurate estimate of total cost of building and thus save scarce resources. The research starts with hypothesis that: The final cost of pre-fabricated housing can be, within reasonable limits, predicted using Neural Networks on a critical set of factors.

## **THE PROBLEM AND THE HYPOTHESES**

The prediction problem in pre-fabricated housing is becoming more and more apparent, especially in transitional and developing economies, i.e. Croatia, where the market has been becoming more open to foreign investors (Izetbegovic, Oreskovic, & Bandic, 2004; Vukomanović, et al., 2008). Every day construction companies have to produce numerous bids, where investors do not have any obligation to even consider them. The gap among realized and unrealized bids is becoming more and more evident. This can only indicate low performance of construction companies in calculating the final cost of building. This problem is becoming even more significant if we put this problem in relation with customer loyalty and long term relations. The aforementioned facts thus motivated us to develop a model for efficient and effective cost prediction and thus solve the above mentioned problem. Hypothesis of this research was defined as:

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