Chapter 31
Neural Networks and Statistical Analysis for Time and Cost Prediction Models of Urban Redevelopment Projects

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ABSTRACT

Over the last few years, a plethora of public works have taken place, focusing towards urban renewal, in the greater Thessaloniki district. Municipality of Thessaloniki, provided data for twelve public projects of urban renewal. Mathematical models have been proposed for cost and time prediction based on regression analysis. Furthermore, the Fast Artificial Neural Network (FANN Tool) was applied, to predict the duration and the final cost of the project, using volume of earthwork, as input variable. Both approaches could facilitate project stakeholders, to forecast the projects' final delivery date and cost and provide early warnings for any deviation from the initial budget. The results indicate that neural networks perform better than regression analysis' models, in the case of urban renewal projects.

INTRODUCTION

According to the Greek Urban Project's Legislation, the definition of Urban Redevelopment is all these residential, social, economic and architectural amendments, which aim at the improvement of both the constructed area and residents' standard of living and the preservation of the cultural elements. The Urban Redevelopment Projects were regarded necessary after a period of time, when the quality of life in cities gradually decreased. The major participants in the above procedure of realizing the project are the owner, also known as the client, the design consultant, the contractor and the construction manager (Antoniou et al. 2013).

DOI: 10.4018/978-1-7998-0414-7.ch031

Kim et al. (2011), cited in Tsaousoglou et al. (2013) suggest that construction industry plays an important role in leading the national economy and macroeconomic fluctuations substantially influence the construction business. Therefore, time and cost forecasting become even more essential for public projects' control. Variation in project costs usually results in exceeding the initial estimated cost (Aretoulis et al. 2006). In the construction industry, a company's success can be directly related to its ability to estimate project's parameters accurately and to control costs and complete the project within budget (Popescu et al. 2003) as cited in Aretoulis et al. (2007). In general, projects that span over a long period of time tend to present time and cost overruns (Eyers, 2001). According to Park (2005) construction management is nothing but resource management. For this reason, resources are recognized as a key to meeting project schedule. Therefore, during the construction phase one important factor that facilitates project cost monitoring and control is the selection of the appropriate construction material suppliers (Aretoulis et al. 2009). Prediction models based on regression analysis and neural networks facilitate this effort. Different cost models have been developed that contribute to a more efficient financial project management. Cost models give a more vivid picture of the costs for the various elements of the project, they help to identify the most appropriate subheadings to monitor the cost reduction and they allow comparison between different approaches to select the optimal solution according to Mitten (1997) as cited in Antoniou et al. (2011). Historical data of similar projects, including final cost or time or the area of the project, are used to predict any required variable. Therefore, availability and access to historical data from similar projects is essential. Research has used statistical methods and neural networks to forecast projects' parameters. The application of such approaches in public urban redevelopment projects has not been found to the best knowledge of the authors. This paper, firstly, describes the sample of the twelve public urban redevelopment projects from the Municipality of Thessaloniki using descriptive statistics. Thessaloniki is the second largest city in Greece, with approximately one million citizens. Prediction models of time and cost are produced via regression analysis. Alternatively, data are analyzed using the FANN Tool 1.2 (Fast Artificial Neuron Network) program. In this way duration and cost prediction of this type of projects becomes feasible, with different reliability measures, associated with each approach.

The paper firstly, presents a number of similar research efforts through a detailed review of the international literature. Methodological approach is analytically depicted, which included: projects' description, correlation and regression analysis and application of neural networks. Then follows a brief discussion on the analyses' results and finally, conclusions and further research are presented.

LITERATURE REVIEW

Cost analysis, project performance, cost and schedule deviations and management have attracted the interest of a plethora of researchers (Aretoulis et al., 2006; Rozenes, 2011; Bellah, Li, Zelbst, & Gu, 2013; Frei, Mbachu, & Phipps, 2013; Kimoto, Yoshizaki, & Ikeda, 2013, Mills, 2013; Ramabodu & Verster, 2013; Phadtare, 2014; Vukomanović & Radujković, 2014; Aretoulis et al., 2015; Larsen, Ussing, Brunoe, & Lindhard, 2015, Antoniou et al., 2016b).

Furthermore, a considerable amount of research has been devoted to prediction models based on regression analysis and neural networks. The main focus of such research initiatives is on time and cost overrun (Motaleb and Kishk, 2013). Such models have focused on the prediction of highway construction duration. In this context, Antoniou et al. (2016a) proposed an easy to apply cost pre-estimating and