Chapter 24
Application of Multiple Regression and Artificial Neural Networks as Tools for Estimating Duration and Life Cycle Cost of Projects

Brian J. Galli

https://orcid.org/0000-0001-9392-244X

Hofstra University, USA

ABSTRACT

Project managers face complex challenges when planning project stages because contract durations and project costs are difficult to predict accurately. The purpose of this study is to investigate statistical tools and concepts that can be integrated in the second phase of the project life cycle: the planning stage. Furthermore, this study aims to compare the accuracy of multiple regression and artificial neural network models, as well as the application of simulation in construction models used in predicting project duration and cost. This paper will also discuss the industry's current estimation methods, the use of statistical approaches, simulation, and the relationship between the application statistical tools and project success. Thus, this review identifies the trending statistical tools used by scholars to develop regression and neural models to solve the complexity of cost and duration estimation. The findings indicate that although the industry needs more accurate predictions and estimating tools, and regardless of the investigations and advancements made with integrating statistical tools, implementing these statistical approaches is faced with barriers.

INTRODUCTION

In the field of project management, the life cycle of a project is composed of the following phases or stages: initiation, planning, execution-monitoring, and project closure. The focus of my investigation is concerned with the planning stage, namely cost estimating and duration estimation. This paper intends to provide an understating of the application of statistical methods and concepts used in the forecasting of cost and durations in construction projects.

The project life cycle, as described previously, lacks the phase of project implementation or post-occupancy planning. Construction projects, such as power plants, treatment plants, buildings, dams, factories and other types of structures, undergo a period of implementation. This paper explores the application of statistical tools for forecasting the running cost for operating and maintaining completed projects. In the context of this paper, operation and maintenance is treated as the last phase of the project life cycle prior to retiring the asset or terminating an initiative.

Furthermore, this paper reports on existing literature, concerning the application of statistical models by industry professionals, to determine duration of contracts, manage cost, and estimate cycle costs. Additionally, we will discuss the steps involved in developing regression and the neural network model. We compare the view of researches and results of regression and neural networks, as well as the advantages and disadvantages of each method.

The literature appears to share the same concept of significant items. Cost significant items refer to elements of the work that influence cost and duration when compared to others. The identification of these items is essential for developing models of high accuracy. Researchers have developed models for various project types, but implementing statistical principles to determine project cost and duration during the planning phase remains low among professionals.

The difficulty of estimating project cost and durations accurately results in a dilated schedule; longer durations will require additional resources, and project cash flows may be impacted. Nonetheless, computer technology advancement and the integration of applications and software have made statistics helpful in estimating project success factors, such as cost estimating, duration, and scheduling. The wide implementation of statistical approaches to estimating is hindered by cost of technology, skill level, and awareness.

Scholars agree that cost is a life cycle constituent of great importance. A poor estimate can make the difference between success and failure, so the accuracy of cost estimates and monitoring is essential to avoid cost overruns (Chew, 2017; Burnes, 2014; Galli, Kaviani, Bottani, & Murino, 2017). As a response to this problem, the industry is adopting modern simulation tools that are gaining ground, as computing power can handle large amounts of data and can perform advanced mathematical and statistical analysis.

A typical construction contract is coupled to a construction schedule that is legally binding. The duration of projects is determined by the owner and consultants. Once the contractor is selected and the contract is awarded, then the contractor must finish on or before the stipulated date. This research will report on the quantitative data processing methods and techniques, such as stepwise regression, multiple regressing, and artificial neural networks. Researchers agree that regression and neural networks are viable methods for estimating project cost and project duration (Adjei-Kumi, 2017; Marcelino-Sádaba Pérez-Ezcurdia, Lazcano, & Villanueva, 2014; Schwedes, Riedel, & Dziekan, 2017).

The current method of estimating durations represents a risk to the contractor, as there is a high probability that the project duration determined by the owner is not reasonable, which makes the contractor liable for penalties and liquidated damages (Jin, 2016; Zwikael, & Smyrk, 2012; Todorović, Petrović,

Related Content

A Method of Estimation for Magnetic Resonance Spectroscopy Using Complex-Valued Neural Networks
Naoyuki Morita (2009). *Complex-Valued Neural Networks: Utilizing High-Dimensional Parameters (pp. 256-283).*
www.irma-international.org/chapter/method-estimation-magnetic-resonance-spectroscopy/6772

Vocal Acoustic Analysis: ANN Versos SVM in Classification of Dysphonic Voices and Vocal Cords Paralysis
João Paulo Teixeira, Nuno Alvesand Paula Odete Fernandes (2022). *Research Anthology on Artificial Neural Network Applications (pp. 612-628).*
www.irma-international.org/chapter/vocal-acoustic-analysis/288977

Particle Swarm Optimization of BP-ANN Based Soft Sensor for Greenhouse Climate
M. Outanoute, A. Lachhab, A. Selmani, H. Oubehar, A. Snoussi, M. Guerbaoui, A. Ed-dahhakand B. Bouchikhi (2022). *Research Anthology on Artificial Neural Network Applications (pp. 1301-1312).*
www.irma-international.org/chapter/particle-swarm-optimization-of-bp-ann-based-soft-sensor-for-greenhouse-climate/289014

Higher Order Neural Networks with Bayesian Confidence Measure for the Prediction of the EUR/USD Exchange Rate
Adam Knowles, Abir Hussain, Wael El Deredy, Paulo G.J. Lisboaand Christian L. Dunis (2009). *Artificial Higher Order Neural Networks for Economics and Business (pp. 48-59).*
www.irma-international.org/chapter/higher-order-neural-networks-bayesian/5276

Analysis and Improvement of Function Approximation Capabilities of Pi-Sigma Higher Order Neural Networks
Junichi Murata (2010). *Artificial Higher Order Neural Networks for Computer Science and Engineering: Trends for Emerging Applications (pp. 239-254).*
www.irma-international.org/chapter/analysis-improvement-function-approximation-capabilities/41669