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Chapter XIV

A Neural Network Approach to Cost Minimization in a Production Scheduling Setting

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Abstract

Cost managers working in manufacturing firms have suffered from the difficulty of determining an optimal cost control strategy. Though the concept of ABC can provide a theoretically nice scheme for cost control, it has been widely known that cost managers have serious trouble comprehending the ABC scheme and applying it to real cost control situations. In this sense, proposing a heuristic method by which cost managers can obtain an approximate cost control strategy comparable to one obtained by ABC would be very meaningful from the view of both theory and practice. To fulfill this need, we suggest using a multi-layered perceptron (MLP) neural network model

with backpropagation learning algorithm, and then approximating the optimal cost control strategy of ABC. The primary concern of this study is to investigate whether such solutions approximated by the MLP would be valid from a statistical perspective. If true, it would mean that cost managers can depend on the neural network method to come up with an optimal cost control strategy comparable to applying ABC. To show the validity of the proposed cost control strategy by using the MLP, this study proposes to solve two problems within the context of a production scheduling situation, using ABC: (1) neural network-based total cost estimation (NNTCE); and (2) neural network-based cycle time estimation (NNCTE). For experimental setup, we assume that two products sharing five types of exogenous variables and three types of endogenous variables are manufactured at the same facility. The MLP neural network approach to NNTCE and NNCTE was generated with a set of 180 training data and 125 test data, all of which were proved to be statistically identical with the ABC results.

Introduction

In the face of increasingly fierce global competition, modern-day manufacturing operations must increase productivity and reduce costs. Because of this, it has become a strategic objective to estimate the various costs of manufacturing more accurately. While traditional cost systems tend to distort cost information by using traditional overhead allocation methods (relying on direct resources such as labor hours), activity-based costing (ABC) has gained a reputation for more accurate cost estimation and calculation methods. ABC traces costs via the activities performed on cost objectives (production or service activities) and results in more accurate and traceable cost information. ABC can help with classifying activities such as value-added and non-value-added, and allows for the elimination of the non-value-added activities (Gunasekaran & Sarhadi, 1998).

ABC was first introduced by Cooper and Kaplan as an alternative to traditional accounting techniques (Cooper & Kaplan, 1988a, 1988b), and has since been used increasingly in multi-level, complex manufacturing organizations (Koltai, Lozano, Guerrero, & Onieva, 2000). ABC models the relationships between products and the resources used in all stages of their production. It is preferable to classical cost calculations because ABC provides a more accurate and consistent way of calculating manufacturing costs (Andrea, Filho, Espozel, Maia, & Quassim, 1999), resulting in more accurate general cost calculations (Kee & Schmidt, 2000). ABC has been applied to various industries (Tsai, 1996), including electronics (Merz & Hardy, 1993), automotive (Miller, 1994), aerospace and defense (Soloway, 1993), airplane manufacturing (Haedicke & Feil, 1991), shipbuilding (Porter & Kehoe, 1994), telecommunications (Hodby, Thomson, & Sharman, 1994), and multi-level, highly automated complex manufacturing systems (Spedding & Sun, 1999; Koltai et al., 2000), among others.

However, one of the most critical problems with ABC is the well-known difficulty of applying it to real-world problems without the need to understand its theoretical complexities. As is often the case, cost managers working in manufacturing firms have