Available online at www.sciencedirect.com
ScienceDirect
Expert Systems with Applications 36 (2009) 660–667
Expert Systems with Applications
www.elsevier.com/locate/eswa

An integrated decision making approach for ERP system selection

E. Ertugrul Karsak [a,*], C. Okan Özogul [b]

[a] Industrial Engineering Department, Galatasaray University, Ciragan Caddesi No. 36, Ortakoy, Istanbul 80840, Turkey
[b] HAVELSAN, Mustafa Kemal Mahallesi, Ankara 06520, Turkey

Abstract

Enterprise resource planning (ERP) systems have gained major prominence by enabling companies to streamline their operations, leverage and integrate business data process. In order to implement an ERP project successfully, it is necessary to select an ERP system which can be aligned with the needs of the company. Thus, a robust decision making approach for ERP software selection requires both company needs and characteristics of the ERP system and their interactions to be taken into account. This paper develops a novel decision framework for ERP software selection based on quality function deployment (QFD), fuzzy linear regression and zero–one goal programming. The proposed framework enables both company demands and ERP system characteristics to be considered, and provides the means for incorporating not only the relationships between company demands and ERP system characteristics but also the interactions between ERP system characteristics through adopting the QFD principles. The presented methodology appears as a sound investment decision making tool for ERP systems as well as other information systems. The potential use of the proposed decision framework is illustrated through an application.

Keywords: Decision making; Quality function deployment; Fuzzy linear regression; Enterprise resource planning; Software selection

1. Introduction

The unprecedented growth of information and communication technologies has influenced all facets of computing applications across organizations. At the same time, the business environment is becoming increasingly complex with functional units requiring more and more inter-functional data flow for decision making, timely and efficient procurement of product parts, management of inventory, accounting, human resources, and distribution of goods and services. To deal with these challenges, new software systems known in the industry as enterprise resource planning (ERP) systems have surfaced in the market targeting mainly large complex business organizations.

ERP comprises of a commercial software package that promises the seamless integration of all the information flowing through the company – financial, accounting, human resources, supply chain and customer information (Davenport, 1998). ERP systems are configurable information systems packages that integrate information and information-based processes within and across functional areas in an organization (Kumar & Van Hillsgersberg, 2000).

ERP software market has been and continues to be one of the fastest growing segments of the information technology (IT) industry. In recent years, globalization and competitive business environment compel companies to invest considerable resources in the implementation of ERP systems. Organizations choose and deploy ERP systems for many tangible and intangible benefits and strategic reasons (Kremzar & Wallace, 2001). Although implementing an ERP system may be costly and time-consuming, its benefits are worthwhile. However, there are a number of examples where organizations have not been successful in reaping the potential benefits that motivated them to make large investments in ERP implementations (Davenport, 1998).

Motwani, Mirchandani, Madan, and Gunasekaran (2002) emphasized that ERP adoption involves initiating

* Corresponding author. Fax: +90 212 2595557.
E-mail address: ekarsak@gsu.edu.tr (E.E. Karsak).

0957-4174/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.eswa.2007.09.016

appropriate business process changes as well as information technology changes to significantly enhance performance, quality, costs, flexibility, and responsiveness. There is a growing consensus among ERP system implementers that selecting an inappropriate system is a major reason for ERP implementation failure. Due to the complexity of the business environment and the diversity of ERP alternatives, ERP system selection is a tedious and lengthy task. Given the considerable financial investment and potential risks and benefits, the importance of selecting a suitable ERP system cannot be overemphasized since it is a decision on how to shape the organizational business (Teltumbde, 2000).

The selection process for determining the most appropriate ERP software among a set of possible alternatives in the market is a multi-criteria decision making (MCDM) problem. This paper introduces a decision model for ERP system selection based on quality function deployment (QFD), fuzzy linear regression and goal programming. The proposed approach benefits from the fact that QFD focuses on delivering value by taking into account the customer requirements and then by deploying this information throughout the ERP system selection process. Fuzzy linear regression is considered as an alternative decision aid for ERP system selection problems where imprecise relationships among system parameters exist. Weighted zero–one goal programming (ZOGP), which aims to minimize the weighted sum of deviations from the maximum achievable customer satisfaction values obtained using fuzzy linear regression, is employed as a means for determining the most suitable ERP system alternative. The advantages of the proposed decision framework can be noted as its ability to consider both user demands and ERP system characteristics, relationships between them, and interactions among ERP system characteristics, without requiring the unrealistic independence assumption frequently encountered in earlier studies addressing ERP system selection.

The rest of the paper is organized as follows: Section 2 provides a concise review of previous works on ERP system selection. In Section 3, a novel decision making framework incorporating quality function deployment, fuzzy linear regression and ZOGP is introduced for ERP system selection problems. In Section 4, an illustrative application of the proposed decision making approach is presented. Finally, concluding remarks are given in Section 5.

2. Literature review

Over the past two decades, software selection has become an active area of research due to its complex and imprecise nature. Lin, Hsu, and Sheen (2007) provide a comprehensive review of software selection applications. In this paper, we limit our focus to methodologies developed for ERP system selection.

The methods which have been applied to ERP or other information system (IS) selection include scoring, mathematical programming, and multi-criteria decision analysis. Owing to its simplicity, the scoring method is one of the most popular methods (Ptak, 2000). Analytic hierarchy process (AHP) based approaches constitute a general class of another commonly used IS selection techniques. Teltumbde (2000) proposed a methodology based on the nominal group technique and the AHP for evaluating ERP systems. In their recent work, Wei, Chien, and Wang (2005) used the AHP to systematically construct the objectives of ERP selection to support the business goals and strategies of an enterprise, identify the appropriate attributes, and set up a consistent evaluation standard for facilitating a group decision process.

Other methods employing nonlinear programming models and zero–one goal programming models are also proposed for the selection of a suitable IS. Santhanam and Kyparisis (1995, 1996) proposed nonlinear zero–one programming models for IS project selection. Santhanam and Kyparisis (1995) presented a multi-criteria decision model for IS project selection which utilizes nonlinear zero–one goal programming. Santhanam and Kyparisis (1996) developed a nonlinear zero–one programming model which considered technical interdependencies among IS projects. The model is transformed to a linear mixed integer programming model through a linearization procedure. Although both of these models improved upon earlier studies by considering interdependencies inherent in the IS selection process, the solution procedure is likely to get complicated as the number of IS alternatives and interactions among them increase.

Wei and Wang (2004) suggested a hierarchical attribute structure model to evaluate the ERP alternatives systematically. They proposed a framework employing an integration model that uses the fuzzy average method and fuzzy integral value ranking for ERP system selection combining data obtained from professional studies with that surveyed from interviews with vendors.

Data envelopment analysis (DEA) approach has been also applied to the process of selecting an ERP system. Early adopters of DEA for decision making used the methodology to screen, respectively limit the number of alternatives, for further evaluation by other multiple attribute decision making (MADM) techniques. Fisher, Kiang, Fisher, and Chi (2004) used DEA to analyze and compare the performance of ERP packages. However, their evaluations are based on information provided by ERP vendors. Lall and Teyarachakul (2006) provided a case study on how DEA can be applied for ERP performance evaluation based on the real corporate data reflecting the organization's needs and requirements. In a recent study, Bernroider and Stix (2006) combined the utility ranking method and the DEA to overcome the limitations of DEA in software selection.

3. The proposed decision framework

In this section, a decision making approach that integrates quality function deployment (QFD), fuzzy linear