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A model for selecting an ERP system based on linguistic information processing

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Abstract

An enterprise resource planning (ERP) is an enterprise-wide application software package that integrates all necessary business functions into a single system with a common database. In order to implement an ERP project successfully in an organization, it is necessary to select a suitable ERP system. This paper presents a new model, which is based on linguistic information processing, for dealing with such a problem. In the study, a similarity degree based algorithm is proposed to aggregate the objective information about ERP systems from some external professional organizations, which may be expressed by different linguistic term sets. The consistency and inconsistency indices are defined by considering the subject information obtained from internal interviews with ERP vendors, and then a linear programming model is established for selecting the most suitable ERP system. Finally, a numerical example is given to demonstrate the application of the proposed method.

Keywords: ERP system; Information systems; Linguistic modeling; Information processing

1. Introduction

In today's dynamic and unpredictable business environment, companies face the tremendous challenge of expanding markets and rising customer expectations. This compels them to lower total costs in the entire supply chain, shorten throughput times, reduce inventories, expand product choice, provide more reliable delivery dates and better customer service, improve quality, and efficiently coordinate globe demand, supply and production [1,2]. In order to accomplish these objectives, more and more companies are turning to the enterprise resource planning systems (ERP). An ERP is a packaged enterprise-wide information system that integrates all necessary business functions, such as product planning, purchasing, inventory control, sales, financial and human resources, into a single system with a shared database [3,4].

A successfully implemented ERP can offer organizations the following three major benefits [5,6]:

- Automating business process
- Timely access to management information
- Improving supply chain management through the use of e-commerce

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In the past few years, thousands of companies around the world have implemented ERP systems. The number of companies that plan to implement ERP is growing rapidly. Since the early to mid-1990s, the ERP software market has been and continues to be one of the fastest growing segments of the information technology (IT) industry [7]. AMR Research, an authoritative market forecast institution in America, indicated that the ERP market would grow at annual rate of 37% in recent 5 years. The sales of the ERP packaged software are estimated to be around $20 billion by the year 2000 and the eventual market size is predicted to be around $1 trillion by the year 2010 [8]. Even in China, a developing country, ERP has also become a main product in the software market and the sales have approached 600 million RMB in the first half of 2002 ([9–11]). Surprisingly, given the significant investment in resources and time, many companies did not achieve success in ERP implementation. It is estimated that the failure rate of ERP implementation ranges from 40% to 60% or higher [2]. Some surveys and researches indicate that successful outcome is also not guaranteed even under ideal circumstances. Researchers consider that the factors such as organizational change and process re-engineering, the enterprise-wide implications, the high resource commitment, and high potential business benefits and risks associated with ERP systems make the implementation a much complex exercise [12,13]. It is therefore not surprising that numerous companies have abandoned their ERP projects before completion or have failed to achieve their business objectives after implementation [14]. Many experts and scholars have investigated this issue from various angles. Some provide valuable insights into ERP implementation process and others identify a variety of factors that can be considered to be critical to the success of an ERP implementation. These factors include top management support, business plan and vision, organizational change management and culture, business process re-engineering (BPR), data accuracy, education and training, and vendor selection and support, etc. ([2,3,5,12,13,15–20]). A successful ERP project involves managing business process change, selecting an ERP software system, implementing this system, and examining the practicality of the system. However, a wrong ERP system selection would either fail the project or weaken the system to an adverse impact on company performance. Due to limitations in available resources, the complexity of ERP systems, and the diversity of alternatives, it is often difficult for an organization to select a suitable ERP system [21].

The complexity of ERP system makes it difficult for a single decision maker to consider all aspects of problem. The organization which plans to implement ERP project usually employs multiple experts from different sections in selection process. ERP system selection, therefore, can be viewed a multi-attribute group decision-making (MAGDM) problem. It involves multiple attributes, which are not easy to quantify. So decision makers must deal with vague or imprecise information in the evaluation process of ERP system. A reasonable approach for dealing with such a problem may be to use linguistic assessment to represent the subjective judgment of decision makers by means of linguistic variables, that is, variables whose values are words or sentences in a natural or artificial language [22,23]. Each linguistic value is characterized by a label and a semantic value. The label is a word or sentence belonging to a linguistic term set and semantic value is a fuzzy subset in a universe of discourse [24]. After Zadeh introduced fuzzy set theory to deal with vague problems, linguistic variables have been used in approximate reasoning within the framework of fuzzy set theory to handle the ambiguity in evaluating data and the vagueness of linguistic expression. Thus, the fuzzy linguistic approach is appropriate for some problems in which information may be qualitative, or quantitative information may not be stated precisely. So far, a number of MAGDM approaches have been proposed for dealing with linguistic assessment information in literatures ([24–32]). These methods can be briefly classified into the following three categories [33]

(1) The approximative computational model based on the Extension Principle.
(2) The ordinal linguistic computational model.
(3) The 2-tuple linguistic computational model.

The models in the first category transforms linguistic assessment information into fuzzy numbers and uses fuzzy arithmetic based on the Extension Principle to make computations over these fuzzy numbers. The use of fuzzy arithmetic increases the vagueness of the results. The results obtained by the fuzzy arithmetic are fuzzy numbers that usually do not match any linguistic term in the initial term set, so a linguistic approximation process is needed to express the result in the original