

A Fuzzy ANP-Based GRA Approach to Evaluate ERP Packages

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ABSTRACT

One of the major problems that most companies face with during the implementation of an ERP system is to determine the best satisfying ERP software based on their needs and expectations. Because an improperly selected ERP software might lead to time loss and increased costs, and in the long run, a loss of market share. Therefore, the ERP evaluation process for companies becomes to a vital point. On the other hand, evaluating ERP software alternatives under a set of criteria leads us to a multiple-criteria decision making (MCDM) problem, and needs to use proper MCDM methods. In the current literature, a number of the MCDM methods have been proposed to solve these kinds of problems, both of which are the analytic network process (ANP) of Saaty, and grey relational analysis (GRA) which has been widely used in solving MCDM selection problems in various fields. Moreover, in this article, the authors used the fuzzy extension of the ANP method to reflect the uncertainty and ambiguity of decision maker(s) into problem in order to reach more reliable solution. As the fuzzy ANP method was used to calculate the priority weights of the evaluation criteria, the GRA method with fuzzy interval-values was employed to rank a set of the possible ERP software alternatives. The proposed approach was also validated in a case study to show its applicability to potential readers and practitioners.

KEYWORDS

Analytic Network Process (ANP), Enterprise Resource Planning (ERP), Fuzzy Logic, Grey Relational Analysis (GRA), Multiple-Criteria Decision Making (MCDM)

1. INTRODUCTION

Enterprise resource planning (ERP) has long been an important issue for today's companies as it integrates the internal and the external management of information across an organization, including finance/accounting, manufacturing, sales and service, so on. On the other hand, the implementation process of an ERP system is also a rather difficult task and entails risk for companies. For that reason, in recent years many companies have opted to purchase off-the-shelf systems to shorten implementation time due to a lack of expertise and experience developing ERP systems in-house. Furthermore, it is difficult for ERP software to fully meet the needs and expectations of a company as each company utilizes varying strategies and has different goals. Therefore, to ensure effectiveness in a business environment, the right software that most closely fits the company's requirements should be

DOI: 10.4018/IJEIS.2019010103

selected. According to Kremzar and Wallace (2001), because of today's rapidly changing and highly competitive environment, ERP systems have become necessary to survive. Although implementing an ERP system may be costly and time-consuming, its benefits outweigh the drawbacks. Careful planning and selection of the right ERP system results in, among other benefits, dramatic increases in responsiveness, productivity, on-time shipments and sales, as well as decreases in lead times, purchase costs, quality problems, and inventory issues.

As discussed above, one of the most critical issues in the implementation of an ERP system is the selection of the right software, because ERP software dramatically changes the structure of a company by integrating its business functions using database technology while also providing more means to improve effectiveness. Nowadays, most companies no longer implement ERP systems themselves, preferring to rely on the full support of ERP software developers or their vendors. The reason for this is ERP software is expensive and requires that a company stipulate its specific needs from the developer or vendor. Therefore, given the fact that there can be a number of alternatives and sets of evaluation criteria, selection becomes an MCDM problem in figuring out which ERP software will provide the best solutions.

In the literature, various methods have been put forward to solve multiple-criteria decision making (MCDM) problems, one of which is the analytic network process (ANP). It was developed by Thomas L. Saaty (1996) and has been widely used in solving the MCDM problems in a variety of fields. It uses uncertain human preferences as input information in the decision-making process and accommodates a variety of interactions, dependencies and feedback between higher and lower level elements. Unfortunately, Saaty's ANP has the following shortcomings: it is mainly used in nearly crisp decision problems, and creates and deals with a very unbalanced scale of judgment. In addition, the ANP method does not take into account the uncertainty associated with the mapping of one's judgment to a number, and its ranking is rather imprecise. On the other hand, the subjective judgment, selection and preferences of decision-makers have great influence on the results. For that reason, we propose introducing fuzzy logic in pair-wise comparisons of ANP to make up for this deficiency, and we refer to this as the "fuzzy ANP."

On the other hand, it should be noted that the GRA method has found significant usage in the literature for cases in which there is uncertainty of information and multiple criteria concerning a decision. Oftentimes in a system of a particular interest, some information is known, some is unknown and some is uncertain, which is referred to as a grey area. The analysis was first developed by Deng (1982) to define these information types, and subsequently the GRA method was developed based on this theory. Although there are different applications of the GRA in literature, in our proposed approach, we used the multiple-criteria decision-making with fuzzy interval-values (Olson, (2006)).

In short, in this paper we propose an intelligent approach to an ERP software selection problem through the fuzzy ANP and the GRA methods. While the fuzzy ANP method is used to calculate the priority weights of the evaluation criteria, the GRA method with fuzzy interval-values is employed to rank a set of the possible alternatives. This proposed approach provides an intelligent and practical approach for companies to evaluate ERP software alternatives given a set of criteria for companies, and is validated via a case study.

2. RELATED LITERATURE

In the literature, a large amount of research addressing ERP issues has been published (Esteves and Pastor, 2001), but as Stefanou (2001) points out there, a limited number of studies have been carried out on the evaluation of ERP software. Some of these are as follows: Sistach et al. (1999) proposed a method covering the entire lifecycle of an ERP acquisition process for small manufacturing companies. Brown et al. (2000) identified business and IT factors that influence ERP purchase decisions, and Zhang et al. (2003) analyzed the critical success factors of ERP systems. Bernroider and Koch (2000) conducted a study on the critical differences between small and large organizations concerning the

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