An ERP software selection process with using artificial neural network based on analytic network process approach

Harun Resit Yazgan [a], Semra Boran [a], Kerim Goztepe [b,*]

[a] Department of Industrial Engineering, Sakarya University, Sakarya, Turkey
[b] Institute of Science, Sakarya University, Sakarya, Turkey

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ABSTRACT

An enterprise resource planning (ERP) software selection is known to be multi attribute decision making (MADM) problem. This problem has been modeled according with analytic network process (ANP) method due to fact that it considers criteria and sub criteria relations and interrelations in selecting the software.

Opinions of many experts are obtained while building ANP model for the selection ERP then opinions are reduced to one single value by methods like geometric means so as to get desired results. To use ANP model for the selection of ERP for a new organization, a new group of expert's opinions are needed. In this case the same problem will be in counter. In the proposed model, when ANP and ANN models are setup, an ERP software selection can be made easily by the opinions of one single expert. In that case calculation of geometric mean of answers that obtained from many experts will be unnecessary. Additionally the effect of subjective opinion of one single decision maker will be avoided. In terms of difficulty, ANP has some difficulties due to eigenvalue and their limit value calculation.

An ANN model has been designed and trained with using ANP results in order to calculate ERP software priority. The artificial neural network (ANN) model is trained by results obtained from ANP. It seems that there is no any major difficulty in order to predict software priorities with trained ANN model. By this results ANN model has been come suitable for using in the selection of ERP for another new decision.

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1. Introduction

ERP is a integrated, consulate enterprise wide information system that combines all necessary business functions like production planning, purchase, inventory control, sales, finance, human resource. Organizations require ERP implementation for the purposes of customer-order integration, standardization of production process, reduction of inventory level and order preparation time, standardization human resources information. Today organizations operate in an economic environment where customer demands are continuously changing and increasing. In today, markets a great number of competitors are in places and competition is so fierce. Quality and cost do not suffice in competition and therefore new competition parameters are needed like delivery date in right time and customize product (Yusuf, Gunasekaran, & Wu, 2006).

These organizations strive to reduce total cost through supply chain, production cycle, and inventory. Additionally, they request increasing diversity of product, more accurate delivery dates and coordinating the supply and production effectively (Liao, Li, & Lu, 2007; Xiuwu et al., 2007).

ERP software automates and integrates business processes and allows information sharing in different business functions. In addition that ERP software supports the finance, human resources, operations and logistic, sale and market in functions by through more effected and productive business process. At the same time it improves the performance of organization's functions by controlling those (Hallikainen, Kimpimaki, & Kivijarvi, 2006). Although organizations can develop their own ERP software, other ones may prefer ready systems to shorten application cycle. The vendors sale ERP software that is developed on different operating system and database in the market. When the organizations prefer to buy ready systems, it is going to be very height cost (Verville & Halingten, 2003).

Therefore ERP selection is an important decision making problem of organization and effects directly the performance. The ERP selection is tiresome and time consuming in terms of complexity of business environment, resource shortages. There are a lot of ERP alternatives in market (Wei & Wang, 2004). The best suitable ERP system selection yields positive results like increasing productivity, timely delivery, reduction of setup time, reduction of purchasing cost. The failure in selection of ERP system leads to the

* Corresponding author.
E-mail addresses: yazgan@sakarya.edu.tr (H.R. Yazgan), boran@sakarya.edu.tr (S. Boran), kerimgoztepe@yahoo.com (K. Goztepe).

failure of project or company performance will get weakened (Liao et al., 2007). The fact that software programs are costly and their adaptation takes too much time so the cost of wrong selection is too high. In past years, the AHP method has been used often for selection of the ERP software, but recently years ANP method has been preferred more than AHP. These methods have been considered as MADM methods.

MADM is a methodology that helps decision-makers makes preference decisions selection regarding a finite set of available alternatives courses of action characterized by multiple potentially conflicting attributes (Chang, Wu, Lin, & Lin, 2007).

The ANP method used selection problems to do following reasons (Liang & Li, 2007):

- With ANP, the criteria priorities may be determined based on pair comparison rates by decision maker's judgment rather than arbitrary scales.
- With ANP, decision-makers can be consider both tangible and intangible factors.
- ANP can transform qualitative values into numerical values to make comparative analysis ANP is so simple and intuitive approach that decision-makers can easily understand and apply it without having professional or special knowledge.
- ANP can motivate all stakeholders and decision-makers to join the decision making process.

The evaluation criteria and alternatives as regards the problems in the ERP software selection presented in this article have been modeled with using ANP. The problem in the model consists of hierarchic order which has goal, evaluation criteria, sub criteria and alternatives. The structure provides holistic approach for multiple criteria decision making problem such as ERP software selection. ANP method can be considered a solution method in order to solve too sophisticated multi criteria decision making problems. While the ANP model for ERP selection is built into reality, many expert opinions are obtained and these opinions come down to one single value through methods like geometric means and thus the results are obtained. If new organization select ANP model to solve ERP selection problem, a new expert group should be established in order to obtain their opinions. Some organization may have some difficulties establishing experts groups. A single decision maker can make ERP selection decision so subjectivity and bayes problem may appear. In order to get rid of difficulties, in this study an ANN model is proposed to use. Every person in the project team complete pair wise comparisons in the ANP model then results of the ANP is going to be use training of ANN model. Consequently, if an organization has a single decision maker, the proposed ANN can be applied to predict the best suitable ERP software.

An important characteristic of the proposed model removes requirement of the establishing group. From the point of difficulties in calculation, an ANP model has difficulties due to eigenvalue and their limit matrix value particularly when number of factors, sub factors and alternatives are large. When the model training is completed, there will be no major difficulty for prediction.

This study consists of five chapters. The second chapter consists of the literature research. The third chapter introduces the methods (ANP and ANN) which are applied in ERP selection. Chapter four is related with application of the proposed model and the results which have been obtained in the last chapter.

2. Literature survey

An ERP software selection is considered to be one of the multi-criteria decision making problems. 0–1 goal programming, which is one of the mathematical programming models, is used together with ANP for information system (IS) project selection and an application is carried out by Lee and Kim (2000). In another study, however Badri and Davis (2001) adopted 0–1 goal programming for IS selection model which they have themselves developed. Karsak and Ozogul (2007) used QFD, fuzzy linear regression and 0–1 goal programming by integrating them in the ERP selection problem. Bernroider and Stix (2006) defined ERP software selection to be multi-purpose decision making system. In their model, they adopted utility ranking and DEA methods. Additionally, they have developed multi attribute utility model and alternative profiles calculated by DEA optimization.

In ERP Selection, AHP/ANP methods have been used. Wei, Chien, and Wang (2005) studied on AHP based ERP selection. Ravi, Shankar, and Tiwari (2005) developed ANP model for ERP software selection problem. In recent studies, one can observe that fuzzy sets have been used together with AHP/ANP methods for ERP Software selection. In ERP selection, a study was made by Ayag and Ozdemir (2007) where a fuzzy ANP was adopted. Literature contains studies in which AHP/ANP and artificial neural Networks have been used together. For example, Stam, Minghe, and Haines (1996) made use of ANN in calculation of dual comparison matrix values in AHP. First, Hopfield network was introduced and this trained network was used in the calculation of comparison data whose absolute values were unknown. The trained network by the help of simulation techniques, proved to be affective in the solution of multi-purpose decision problems depended on vague or fuzzy data especially when data was uncertain and fuzzy. In their relevant study, Hu and Tsai (2006) studied the case where the data for the comparison matrix was partly missing and they have proposed to find the missing data by way of back propagation method.

The multi-layer back propagation they have proposed estimates the missing data and enables the usage of AHP. Kuo, Chi, and Kao (2002) developed fuzzy AHP structure for the selection of the most convenient store place problem. They also studied the interrelations between factors and store performance by ANN model. Hu and Tsai (2006) developed multi-layer ANN model to calculate dual comparison which have been used in AHP approach. ANN model, which they proposed, estimates the calculation of missing dual comparison data from the present dual comparison and thus completes the missing dual matrix data. Chao and Skibniewski (1995) determined the performance characteristics of each of sample technology by AHP for the problem of the acceptance of new technology in construction industry and estimated the acceptance of new technology within certain performance criteria with ANN model.

Matsuda (2006) dealt with the problem in case of missing or no information when the decision is made with ANP based ANN model and tested the validity of his model with simulation. Mikhailov (2004) studied on the determination of group priority in AHP method. He mentioned that the usage of his fuzzy based optimization method in reducing the group decisions to a single one and priorities to a single value is more appropriate than the usage of geometric mean method of Aczel and Saaty (1983). In his study, a fuzzy approach has been implemented to solve the problem in the case of missing information of the group members.

3. ANP and ANN methodology

3.1. ANP method

Saaty (1980) firstly developed AHP method to solve the problems of MCDM. But, in AHP method, interdependence and feedback that may be seen in evaluation criteria has not been defined. To make up for these deficiencies, an ANP method was developed