

Presentation Pattern and Fuzzy Approach in the Implementation of Enterprise Resource Planning

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Abstract

ERP system implementation project on the one hand requires considerable's financial investment. And on the other the structure and infrastructure has a great impact on organizational performance, therefore requires adequate pre-feasibility and preliminary studies. The experiments show that one of the main reasons for failure in the implementation of enterprise resource planning system is inappropriate selection of ERP package. Considering the number of ERP software packages providers, there is considerable differences between features and the way of supporting of software. Therefore the correct choice requires consideration different kind of both quantitative and qualitative criteria. On the other hand the uncertainty and reliability must be considered in evaluating the decision-makers. To achieve this, the framework consists of methods for fuzzy multiple criteria decision making (MADM) and ranking method of fuzzy approach for the evaluation and selection of Enterprise Resource Planning systems is presented.

Keywords: evaluation and selection fuzzy multiple criteria decision making (MADM), Enterprise resource planning (ERP),, fuzzy ranking

Introduction

All scholars and experts in the past two decades emphasized the changes in environmental conditions and forms of business organizations. The formation of global economy and globalization, changing workforce and the types of customers who are able to impose their demands on manufacturers is triggered a stressful environment with many challenges for organizations today [1]. Among these, organizations are successful using new management tools and technologies, could take advantage of the created opportunities [2]. Feasibility before applying any changes will help to gain knowledge and awareness. Feasibility reduces the change risk and will save time and cost. Implementation of Enterprise Resource Planning systems (ERP), including projects that because of its importance, both from a financial and investment aspect, structural and infrastructural aspects needs feasibility studies before it is implemented.

While the extensive work was done in the field of information systems implementation, but in the field of evaluation and selection them has not been done scientific and research work [3]. In this paper, a brief introduction of enterprise resource planning systems is introduced and critical criteria for evaluating and selecting of ERP software systems providers is investigated. Several criteria must be considered in such a choice; On the other hand mechanism should be adapted to covers uncertainty in identifying and assessing. To achieve these objectives, in the end of this paper a framework for selecting an appropriate ERP for the organization is provided. In this framework, the combination of fuzzy multiple criteria decision making (MADM) and a fuzzy ranking method for the evaluation and selection of the best choice of Enterprise Resource Planning systems is used.

What is Enterprise resource planning system (ERP)?

ERP is a thought, technology and management system for high performance on a variety of sources in an organization. This kind of management is done through integrating of activities in order to enhancing the efficiency and productivity of the organization and customer satisfaction improvement. ERP shows all operational steps in a process in an organization. After receiving an order is directed to design and production section. Then goes to warehouse section and finally shipping. The steps up to the billing and revenue calculations in connection with the order will be recorded in the ERP system in the company and made available to all relevant sectors. Therefore, the ERP is called a Back - Office software. Because it only deals with communication and internal units of organization and not to the external communications (known as the front - Office). These functions are now the responsibility of the CRM system. Some ERP software packages producing companies currently offer CRM services with their product.

Status of ERP systems in organization

In general, in macro level, two groups of information systems are classified to information systems management support and information systems operations support. Some of the Operations Support Systems include:

1 - Transaction Processing System (TPS): These systems are responsible for information processing of business processes.

2 - Process control systems (PCS): These systems are responsible for the task of controlling the production process.

3 - Office Automation Systems (OAS): These systems are responsible for office automation tasks.

Some management support systems include:

1 - Management Information Systems (MIS): these systems provide information to help management to support daily decisions (structured decisions) at various levels.

2 - Decision Support Systems (DSS): These systems provide information to help senior and middle level management decisions for non-structured ones.

3 - Executive Information Systems (EIS): The system provides specific information for senior and middle management to achieve organizational strategic objectives.

The Role of Enterprise Resource Planning system (ERP) in relation to management information systems in organizations is shown in Figure 1(16).

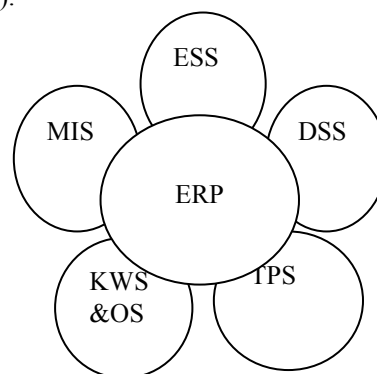


Figure 1. Status of enterprise resource planning systems (ERP) in relation to other information systems

Selecting an appropriate ERP

Even though most ERP systems and packages seem very similar to each other but are significantly different in structure. On the other hand the implementation of enterprise resource planning system requires a significant investment both financially and in terms of time. Therefore, the selection process of enterprise resource planning system of systems available on the market, is very difficult and troublesome and must be done carefully and patiently. Studies show that most companies in return on investment in this area are deficient between 25 and 50 percent, the losses are because of ignoring one or more phases of the process of selecting an appropriate software package, in such a situation the selected system will not overlap perfectly with the needs of the company.

Today, more than 300 companies are working as ERP Supplier worldwide, and each of them introduces their product as they can fulfill all the needs and demands of the organization. In such a situation, the question arises that despite the wide range of producers and providers of products, how it will be acted to overcome not only the risks but also achieve the intended benefits?

What professionals and experts have proposed about this worldwide, is Moving in path for not to encountering risk during this step by step critical path. Jacques Verville et al (2002) offered a six-step model for supply and purchase of ERP software. This process includes planning, information seeking, and initial selection, evaluation of alternatives, selection and negotiation [4]. CJ Stefanou Emphasize the importance of selecting an appropriate ERP, proposed a conceptual framework for evaluating ERP software. He maintained that the ERP selection and evaluation should consider both strategic and operational criteria [5]. Strategic Planning is in the first place for ERP implementation. A strategy should be in accordance with available resources, conditions and goals. To achieve a specific strategy, present situation and path directed toward target always should be considered. Operational criteria refer to the actions and activities that make strategies operational and resulted in achieve to objectives. In other research, Tunc & Burgoon listed the expectations of each of the different parts of the ERP, in different part of organizations, For example, in the human resources department, information that should be in terms of personnel as a customer oriented standard has been proposed [6]. In general, in order to establish a framework for the successful implementation and achieving maximum investment rate, nine steps in the process of selecting an appropriate ERP system is proposed as shown in Figure 2.

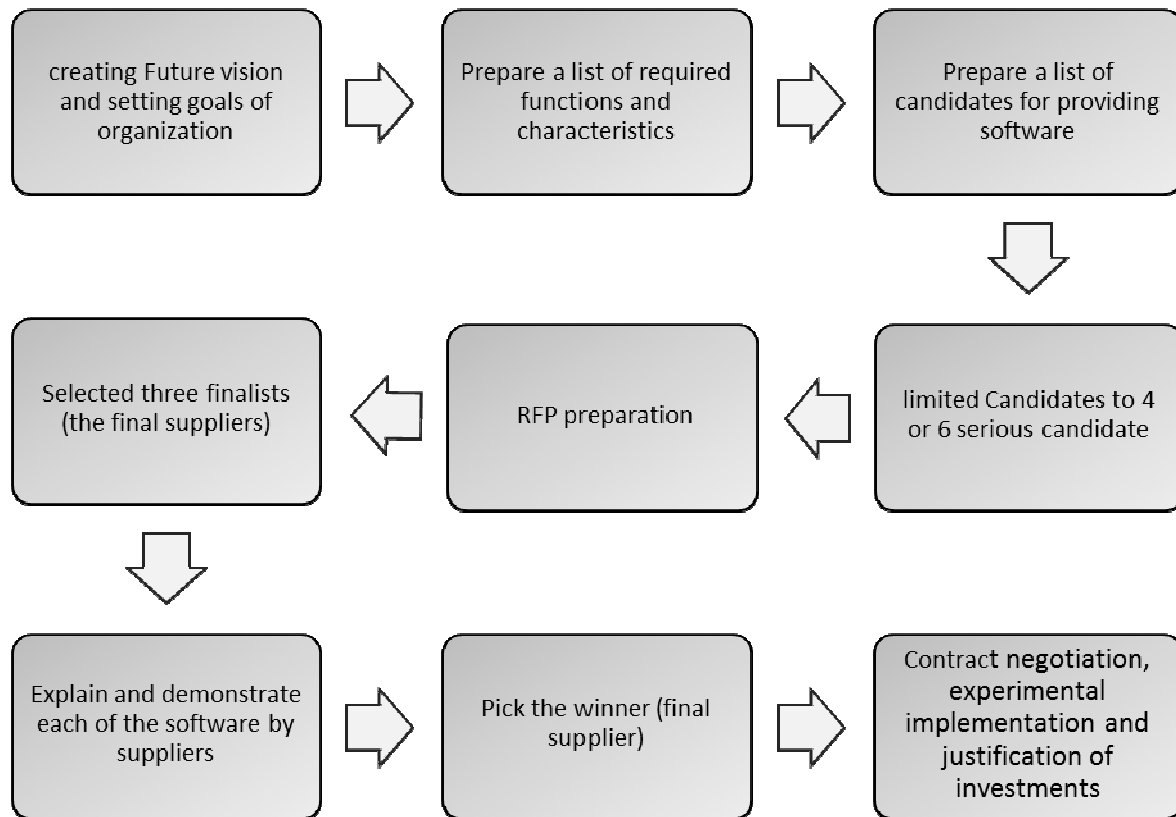


Figure 2: The process of selecting an appropriate ERP system

Proposed framework for selecting ERP

In everyday life we are faced with different situations that need to decide to choose one of the available options. Application of fuzzy sets in decision making field is done by changing the classical theories to fuzzy ones. While decision-making under conditions of risk has been formulated using probability and game theory, Fuzzy decision theories are used in order to deal with ambiguity and non-essential features of the priority, constraints and objectives formulation. Fuzzy logic includes a range of theories and techniques that essentially are built based on four concepts; Fuzzy sets, linguistic variables, probability distribution (membership function) and fuzzy if - then rules [7]. A fuzzy set is a set that its elements belong to the set with membership degree of μ . In situations where the required information are Quantitative they expressed numerically, However, when conducting research is qualitative and its knowledge has uncertainty, the information cannot be expressed as exact numbers. Most managers can not expressing their idea with a precise number, And therefore the verbal assessments was used rather than specific numerical values [8]. Therefore, the fuzzy sets theories is very important because of considering uncertainty and uncertainty in decision making, Especially in cases where decision making is about human resources and complex systems. In this paper we use a combination of fuzzy multi-criteria decision making and fuzzy ranking methods for selecting appropriate ERP software.

Multi-criteria decision-making techniques are divided into multi-objective decision making models and (MODM) and multi-attribute decision making models (MADM). Multi-objective models are used to design and the multi- attribute models are used to select the best choice [9]. Multiple attribute techniques and group decision-making are used extensively in the literature, and provide the ability of evaluating the options for managers and decision-makers [10]. The following reasons can be mentioned for using the fuzzy MADM techniques in the proposed framework [11] (in this paper is called the fuzzy multiple criteria decision making):

- 1 – The method that is used by decision makers in the case of quality criteria is either literal or verbal.
- 2 - The credibility of fuzzy MADM methods, due to the possibility of entering personal and inaccurate comments of decision makers, is high.
- 3 - Fuzzy MADM methods can be used easily for simultaneous evaluation of qualitative and quantitative

criteria for each unit and scale.

4 - In cases where the weight of the criteria is not clear, the use of fuzzy MADM is recommended instead of classic MADM methods.

5 - Fuzzy MADM problems solving method that used verbal variables, is one of the best ways to deal with the issues that have large dimensions.

6 - In this method there is the possibility of applying the group decision maker's opinion directly in the model.

7 - The use of fuzzy technique cause not wasting any right of decision makers.

Multi-attribute decision-making methods

In reality, decisions are often multi- attribute and the appropriate or inappropriate criteria of decisions is usually more than one? To understand the proposed framework, first multiple attribute decision making techniques should be introduced. In This method primary data are collected based on decision-makers opinions and in the form of Decision making matrix and it will be the base for final decision. MADM methods will determine the best choice based on mathematical reasoning and prioritizing [12].

In Multi Criteria Decision Making methods to prioritize and select the best choice we use n alternative and m criteria. Let $X = \{x_1, x_2, x_n\}$ and $C = \{c_1, c_2, c_m\}$ be, a set of alternatives and a set of criteria characterizing a decision situations, respectively.

The basic information involved in multi criteria decision making can be expressed by the matrix:

$$\begin{pmatrix} r_{11} & \cdots & r_{1n} \\ \vdots & \ddots & \vdots \\ r_{m1} & \cdots & r_{mn} \end{pmatrix}$$

Columns are attributes and Rows of matrix are alternatives, that are $X = \{x_1, x_2, x_m\}$ and $C = \{c_1, c_2, c_m\}$ respectively.

Assumes first that all entries of this matrix are real number in $[0, 1]$, and each entry r_{ij} express the degree to witch criterion c_i is satisfied by alternative x_j ($i \in N_m, j \in N_n$). Then R may be viewed as a matrix representation of a fuzzy relation on $C \times X$.

It may happen that, instead of matrix R with entries in $[0, 1]$, an alternative matrix converted to the desired matrix R by the formula:

$$r_{ij} = \frac{r'_{ij} - \min_{j \in N_n} r'_{ij}}{\max_{j \in N_n} r'_{ij} - \min_{j \in N_n} r'_{ij}}$$

For all $i \in N_m$ and $j \in N_n$.

The most common approach to multi criteria decision problem is to convert them to single- criterion decision problems. This is done by finding a global criterion, $r_j = h(r_{1j}, r_{2j}, \dots, r_{mj})$, that for each $x_j \in X$ is an adequate aggregate of values $r_{1j}, r_{2j}, \dots, r_{mj}$ to witch the individual criteria c_1, c_2, \dots, c_m are satisfied.

A frequently employed aggregating operator is the weighted average:

$$r_j = \frac{\sum_{i=1}^m w_i r_{ij}}{\sum_{i=1}^m w_i} \quad (j \in N_n)$$

Where w_1, w_2, w_m are weights that indicate the relative importance of criteria c_1, c_2, c_m . A class of possible weight exaggerations is given by the formula:

$$r_j = h(r_{1j}^{w_1}, r_{2j}^{w_2}, \dots, r_{mj}^{w_m})$$

Where h is an aggregation operator and w_1, w_2, w_m are weights.

Consider now a more general situation in which the entries of matrix R are fuzzy number r_{ij} on R^+ , and weight are specified in terms of fuzzy numbers w_i on $[0,1]$. Then, using the operations of fuzzy addition and fuzzy multiplication, we can calculate the weighted average r_j by the formula;

$$r_j = \sum_{i=1}^m w_i r_{ij}$$

Since fuzzy numbers are not linearly ordered, a ranking method is needed to order the resulting fuzzy number r_1, r_2, \dots, r_n . For this purpose we use the one of the simple fuzzy ranking methods here.

Fuzzy ranking method

This method is based on α -cuts. In fact, a number of variations of this method have been suggested in the literature. A simple variation of this method proceeds as follows. Given fuzzy numbers A and B to be compared, we select a particular value of $\alpha \in [0,1]$ and determine the α -cuts ${}^\alpha A = [a_1, a_2]$ and ${}^\alpha B = [b_1, b_2]$, then we define

$$A \leq B \text{ if } a_2 \leq b_2$$

This definition is, of course, dependent on the chosen value of α . It is usually required that $\alpha > 0.5$.

Multi person decision making method

A social choice function must then be found which, given the individual preference ordering, produces the most acceptable overall group preference ordering. Basically, this model allows for the individual decision makers to possess different aims and values while still assuming that the overall purpose is to reach a common, acceptable decision. In order to deal with the multiplicity of opinion evidenced in the group, the social preferences S may be defined as a fuzzy binary relation with membership grade function

$$S: X \times X \rightarrow [0, 1]$$

Which assigns the membership grade S (x_i, x_j), indicating the degree of group preference of alternative x_i over x_j . The expression of this group preference requires some appropriate means of aggregating the individual preferences. One simple method computes the relative popularity of alternative x_i over x_j by dividing the number of person preferring x_i to x_j , denoted by N (x_i, x_j), by total number of decision makers, n. this scheme corresponds to the simple majority vote. Thus,

$$S(x_i, x_j) = \frac{N(x_i, x_j)}{n}$$

Once the fuzzy relationship S has been defined, the final non fuzzy group preference can be determined by converting S into its resolution form. [15].

$$S = \bigcup_{\alpha \in [0,1]} \alpha^\alpha S$$

The proposed decision framework is presented in Figure 3 [15].

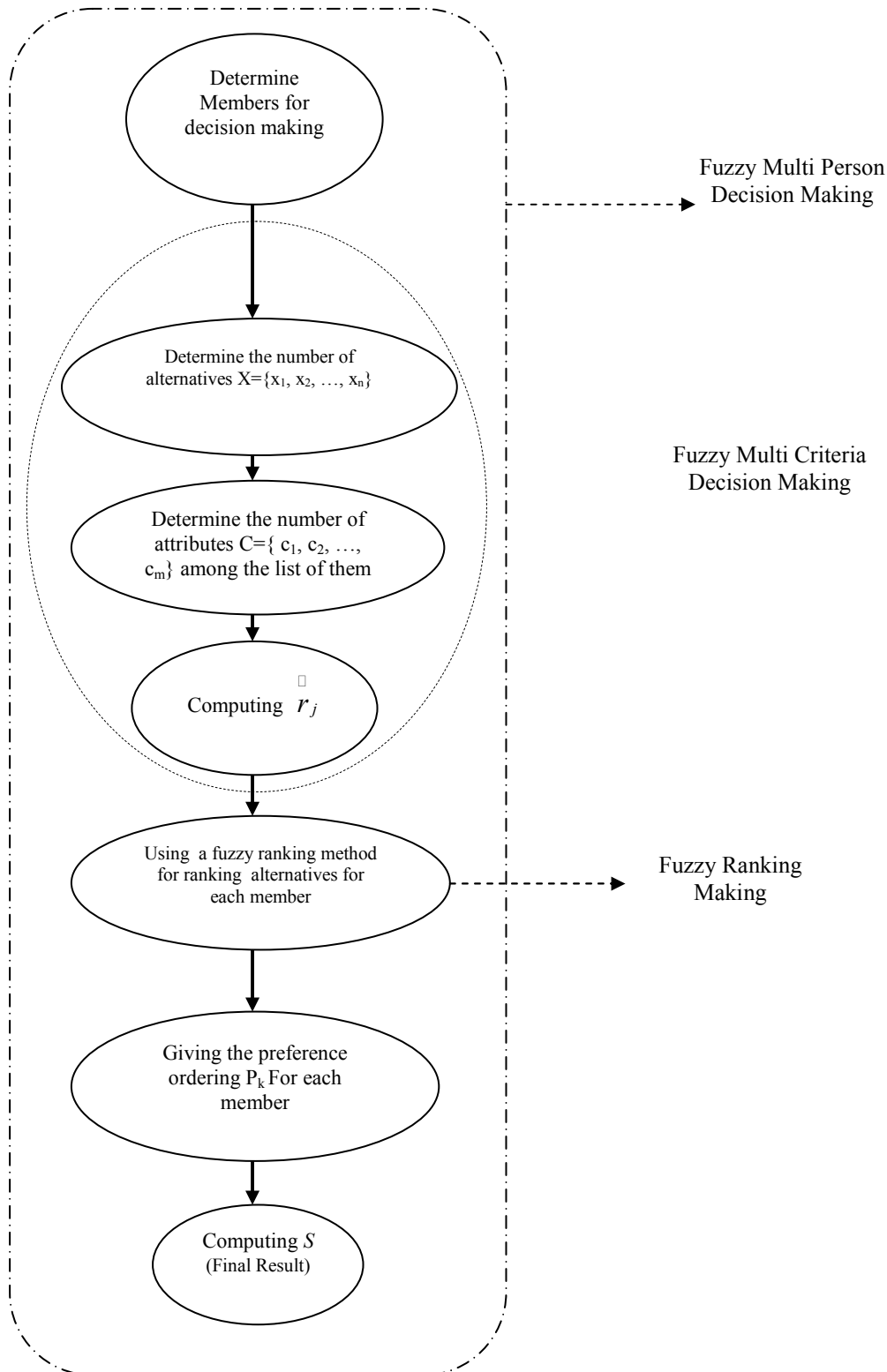


Figure 3: Proposed Framework

Conclusion

Mistakes and inaccuracies in important decisions, leads to pay for errors. Whatever The managers' power is higher, the cost for the wrong decision is higher [13]. The experiments demonstrate that one of the main reasons for failure in the implementation of enterprise resource planning is inappropriate selection of ERP package. Because there is uncertainty in complex decision-making, this paper presents a framework in which a fuzzy multi-criteria decision-making method is used to select the appropriate software [14]. In the presented

framework a fuzzy multi-criteria decision method, and a fuzzy ranking method is used to select the right software for the organization. The proposed framework covering both quantitative and qualitative criteria involved in the evaluation and selection of Enterprise Resource Planning systems, and mentioned uncertainty in process of decision making.

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