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# Using AHP Technique and Fuzzy VIKOR Technique to Select a Dynamic Enterprise Resource Planning System in Rayan Pardazesh Co. Case study

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***Abstract*** *To have a successful enterprise resource planning (ERP) system within the organization, managers and experts of the organizations should study these systems carefully and consider advantages and disadvantages of each software product and select the product that is the most appropriate product for the status of the organization. The main purpose of this study is to choose the best ERP system for a large publication company and assessment of weighted load and the impact of each effective factor on this system. In this study, Kolmogorov-Smirnov Test is firstly used to test normality of data and Wilcoxon signed-rank test is used to test the hypotheses. In second step of the research, to select appropriate software, AHP method is used for weighting and Fuzzy VIKOR method is used to select the best ERP system. The results obtained from the study have shown that EPICOR system is the most appropriate and the best system to be implemented in the said company due to its conditions and needs and the software capabilities with highest weighted load (0.5650) are identified as the index with most effect on choosing ERP system.*

***Key words*** Flexibility, enterprise resource planning (ERP), AHP, Fuzzy VIKOR, software capabilities

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## 1. Introduction

To enhance productivity and for better decision making and to achieve competitive advantage, organizations tend to use systems with the capability to collect data existed within the organization in all fields of organizational activity in an integrated form and provide the information and the results obtained from the data for the users in different fields of the organization. Enterprise resource planning (ERP) is a system that can link all parts, interactions and processes of an institute to enhance productivity and to optimize interactions through integrated computerized system (Bozorgmehri 2007). In other words, ERP could be considered as a software package with the aim of integration of information among all organizational departments (Cebci 2009). If ERP system is selected properly, it could be considered as a good decision support system for enterprises and can create competitive advantage for them (Tsai et al. 2009). At the same time, if right option is not selected, the enterprise will face some problems in steps of system implementation and deployment. The more the selected option is adjusted with organizational requirements, the more the future changes in system are decreased and the risk of implementation and deployment is also decreased. If system functions are not adjusted with organizational requirements, the processes of the organization should be changed to adjust them with system or a system should be ordered with the ability of supporting processes. In both cases, time and cost of implementation is increased and system implementation risk is also increased. In this case, due to high volume of changes, the probability of resistance against changes is also increased in employees. Therefore, careful selection of software and a product based on organizational needs can reduce the time and cost of system implementation and system deployment success (Oliver and Romm 2000; Tsai *et al*., 2009). This can clear importance of selection of appropriate software system. The reality is that appropriate ERP system selection based on goals and requirements of businesses is one of the most important issues neglected by majority of businesses. On the other hand, lack of lack of proper information of authorities about scientific decision making methods and

lack of exchange of academic and professional information can lead to inability of proper decision making by managers and can cause irreparable losses for enterprises.

The main purpose of this study is to select the best ERP system for a large publication company due to enterprise goals and requirements and through measurement of weighted load and the effect of each effective index on the selected system. The results of this study could help better decision making of managers to select appropriate software system for better implementation and to reduce risk of ERP projects. In this study, the enterprise requirements are firstly identified based on enterprise goals and strategies and then, the main indices affecting ERP system selection based on enterprise needs are evaluated. Finally, AHP technique and FVIKOR technique are used to identify the best software system for the studied organization.

## 2. Literature review

Different studies have been conducted in field of types of ERP system selection methods such as Chien, Tsai, lien and Liang and so on.

Wei *et al.* (2005) have conducted a study and used an approach based on AHP to select ERP system. In the study, they have provided a framework to select an appropriate ERP system. In a study conducted by Tsai *et al*., organizational factors to select ERP software package and its supporters are provided. The results of the study showed that many factors have been significantly depended on type of software that is local and is adjusted with the culture and organizational structure (Tsai *et al*., 2009). Lien and Liang (2005) introduced a systematic framework to select ERP, in which two fields of qualitative model of MACCALL software with project management orientation and FAHP analysis are considered.

Vervile and Holingten (2003) have also introduced some factors to select ERP software. In this study, they have investigated the main aspects of selecting software and relevant factors of ERP software.

In the study conducted by Lee Loung (1998), a decision support system is proposed with regard to qualitative and quantitative criteria to select the best integrated computerized production system.

Khanal and Arneja (2012) selected a strategy to use appropriate ERP system. This study has been conducted on the relationship and strategy transfer among 3 primary risks of individuals, processes and technology and trust and better use of ERP system could help better identification of the strategy and combination of strategies to improve the system (Khanal and Arneja, 2012).

ERP systems could be defined as integrated software systems with different elements and modules in operational fields of organizations like planning, production, sales, marketing, distribution, accounting and human resource management (HRM). ERP systems have the ability to provide integration of information in organizational level and to provide the information among different departments of the organization through using a general database taking integration mechanism (Olhager and Selldin 2003; Clyde and Sena 2005).

According to Jacobs and Weston (2007), one key way to use ERP successfully is the way, in which the users can organize the program in such manner that it can facilitate the application. ERP system can reduce time cycle, accelerate data distribution and improve financial management and can also base its affairs on E-commerce. Moreover, it can create transparent tacit knowledge that is used appropriately by individuals in a business organization (Davenport 2000).

The advantages of ERP system has resulted in wide use of these systems by majority of organizations across the world; although inattention of many organizations has led to failure and inefficiency of the project and high costs without considering requirements of business and consistency of selected system with the organizational goals and strategies. Hence, choosing the best system is very important. Therefore, this study is aimed in answering two questions as follows:

***1.*** *What are the effective indices and importance of these indices to select an appropriate ERP software system for the Rayan Pardazesh Publication Company?*

***2.*** *What is the most appropriate ERP software system for Rayan Pardazesh Company?*

Various studies have been conducted in field of effective indices to select appropriate ERP system. Marius and Ashok (1996) believe that using a successful ERP system is highly associated with proportion of software system capabilities with the organizations and organizational users. Fougatsaro (2009); Baki and Cakar (2005); Kumar *et al.* (2003) believe that capabilities of software system such as perfection of modules

and relevant subsets for all parts and covering all activities in each department, consistency with type of organizational activity and considering security issues are the main issues expected from an ERP system.

Therefore, based on available theories, hypothesis 1 could be conceptualized as follows:

- *Hypothesis 1: software capabilities could be among effective indices in selecting ERP system.*

Flexibility refers to the ability to be changed and consistency with organizational structure (Alebnay 2005). Kumar et al (2003) believes that stability and reliability of system and flexibility and its consistency with organizational systems could be two important and determinant factors in selecting successful ERP system. Moreover, Fougatsaro (2009) believes that system flexibility should be in such manner that ERP strategies could be designed based on organizational growth and various predictions are provide for development of organizational activities in future, so that all advancements of the organization could be implemented in it with lowest costs.

Accordingly, hypothesis 2 would be as follows:

- *Hypothesis 2: system flexibility and stability are effective indices in selection of ERP system.*

Alebnay (2005); Fougatsaro (2009); Ziaee *et al.* (2006) believe that cost is a very important factor affecting ERP system selection, since the organization should have the ability to pay and supply required budget to implement this system. These costs include software costs, hardware costs, application, maintenance cost, training cost, order making cost, costs of advisor and so on. Yvonne *et al.* (2000) believe that selecting an ERP system is under effect of factors such as low costs, being user-friendly, consistency with business procedures, scalability, support and training.

Therefore, hypothesis 3 is as follows:

- *Hypothesis 3: implementation cost is a factor affecting ERP system selection.*

The services provided by seller could be considered as one of the key factors in selection of an ERP system. These services include service speed, credit of seller, training and consultation services and support services. Adina *et al.* (2007) believe that the aim by service speed is the speed to have access to service and the responding time and the aim by credit of seller is that how long the seller has been active in this business? How long the seller is selling this software system? How many local and international users use this system? Somer and Nelson (2004) believe that right selection of software system and successful use of this system is depended on training users. Appropriate user training can lead to satisfaction of the users in using system and enhancement of their knowledge and expertise.

Fougatsaro (2009); Kumar *et al.* (2003); Baki and Cakar (2005); Eric *et al.* (2008) claim that an important issue after implementation of ERP system is support. These supports include wide technical supports by the supplier, maintenance, updates, service responding, providing services, relevant supports of order making, design and user training and consultation.

Accordingly, hypothesis 4 is presented as follows:

- *Hypothesis 4: services supplied by the supplier could be effective indices in selecting ERP software system.*

***Fuzzy VIKOR Technique***

VIKOR technique was introduced for the first time by Opricovic (1998) to solve multivariate decision making problems and to achieve to the best compromise solution. In other words, this approach is used to rank and select a set of options and to determine consistent solutions for a problem with different criteria and helps the decision makers to achieve optimal solution for decision making (Chen and Wang 2009).

Wang et al (2005) introduced Fuzzy approach for the first time. This approach is a systematic and logical process to achieve to the best solution and is used to solve fuzzy multivariate decision making problems (Chen and Wang 2009).

***Steps of Fuzzy VIKOR Technique***

1. Formation of decision matrix
2. Evaluate the fuzzy importance weight of criteria
3. Determine the best and the worst values
4. Compute the utility measure (S) and the regret (R) measure
5. Compute VIKOR index (Q) for each option
6. Rank the order of preference based on Q, R and S values
7. Determine final answer

*Step 1:* formation of decision matrix: the structure of this matrix is as follows:

$$D = \begin{pmatrix} & C_1 & C_2 & C_3 \\ A_1 & X_{11} & X_{12\ldots} & X_{1n} \\ A_2 & X_{21} & X_{22\ldots} & X_{2n} \\ A_3 & X_{m1} & X_{m2\ldots} & X_{mn} \end{pmatrix} \quad (1)$$

In this matrix, A1 refers to option i; $C_j$ refers to j index and $X_{ij}$ refers to Ai option value due to $C_j$ index; $X_{ij}$ is the function of i alternative in relation with j index.

*Step 2:* Evaluate the fuzzy importance weight of criteria

In this step, according to significance coefficient of different criteria of decision making, weight of criteria is determined using methods such as Entropy or AHP:

$$\mathrm{W} = \{\mathrm{w}_1, w_2 \ldots w_n\} \quad (2)$$

*Step 3:* Determine the negative and positive ideal point

If:

$$f_j^* = maxx_{ij}, \ j=1,2,\ldots n \quad (3)$$

$f_j^*$ Could be the best positive ideal solution for j criterion:

$$f_j^\circ = minx_{ij}, \ j=1,2,\ldots n \quad (4)$$

And is the worst negative ideal solution for j criterion

Moreover, if:

$$F_j = l_j^*, m_j^*, r_j^*, \ F_j = l_j^\circ, m_j^\circ, r_j^\circ \quad (5)$$

Making fuzzy difference could be non-scaled using equations 6 and 7. For utility factor:

$$d_{ij} = \frac{f_i^* - x_{ij}}{r_i^* - l_i^0} \quad (6)$$

For cost factor:

$$d_{ij} = \frac{x_{ij} - f_i^\circ}{r_i^0 - l_i^\circ} \quad (7)$$

Computing the best and the worst values of each index based on D standardized matrix.

*Step 4:* Compute the utility measure (S) and the regret (R) measure

$$s_i = \sum_{j=1}^{J} (w_j \times d_{ij}) \quad (8)$$

Where; Si refers to distance of i from the positive ideal solution (the best solution).

Now, to obtain the worst solution or the distance of i from negative ideal solution, equation 9 is used:

$$R_i = max_j(w_j \times d_{ij}) \quad (9)$$

*Step 5:* Compute VIKOR index (Q) for each option

If $S_i^{\sim} = (S_i^l, S_i^m, S_i^r)$ , $Q_i = (Q_i^l, Q_i^m, Q_i^r)$ (10)

And if;

$$R^{0r} = max_i R_i^r \quad (11)$$

$$R^* = min_i R_i \quad (12)$$

$$S^{0r} = max_i s_i^r \quad (13)$$

$$S^* = min_i s_i \quad (14)$$

Then, Q is calculated as follows:

$$Q = v\left(\frac{s_j}{s^r} - \frac{s^*}{s^{*L}}\right) + (1-v)\frac{R_j}{R^r} - \frac{R^*}{R^{*l}} \quad (15)$$

V refers to maximum group desirability and is usually considered equal to 0.5.

***Defuzzification***

In fuzzy logics, defuzzification is the process of changing fuzzy numbers to non-fuzzy numbers. It is the process that maps a fuzzy set to a crisp set. In fact, in different approaches using fuzzy technique, the author finally tends to change the fuzzy set to a crisp and understandable set. In this study, following method is used for defuzzification:

$$n = (l, m, r) \quad (16)$$

$$Crisp(N) = \frac{2m+l+r}{4} \quad (17)$$

*Step 6:* Rank the order of preference based on Q, R and S values
In this step, alternatives are ranked through ordering Q, R and S values in downward mode.

*Step 7:* determine final answer
For decision making, two conditions are evaluated and based on the 2 conditions, 3 states are created, based on which final answer is determined:

a) Conditions 1: acceptable advantage

If $A^{(1)}$, $A^{(2)}$ and $A^{(l)}$ are respectively the first, second and the worst options based on Q value and n refers to number of options, equation 18 would be written as follows;

$$[Q(A(2)) - Q(A(1))]/\,[Q(A(I)) - Q(A(1))] \geq 1/n - 1 \quad (18)$$

b) Condition 2: acceptable stability in decision making

The option $A^{(1)}$ should be recognized at least in one group of R and S as the best rank; if so, 3 states are created:

State 1: when the condition 1 is not provided, a set of options are selected as equation 19 as top options:

$$top\ options = A(1), A(2), A(M)\ \ldots\ldots, \quad (19)$$

State 2: when only condition 2 is not provided, $A^{(1)}$ and $A^{(2)}$ are selected as top options.

State 3: if both conditions are provided, ranking is based on Q (in declined form: the less the Q, the better the option).

### *3.2. Case study*

This study has been conducted on a large publication company in Tehran. In this study, the main purpose is selecting an appropriate software system for Enterprise Resource Planning (ERP) based on requirements, goals, strategies, culture and organizational structure of studied company to meet organizational needs properly and to reduce costs and create competitive advantage for the company. For this purpose, a committee of CEOs of the company is used and after taking advises of project team, requirements of company are collected. Then, using library method and supports of project team, due to enterprise requirements, main indices to select the best ERP system are identified. Confirmation and extraction of these indices is done through testing hypotheses and with the help of experts of this field. After extraction of final indices, different software systems with most access and consistency with extracted indices and with acceptable costs for the enterprise are evaluated and 4 systems are selected as follows:

System A= BACH MASTER
System B= ERP 123
System C= EPICOR
System C= SAP

***Extracted indices***

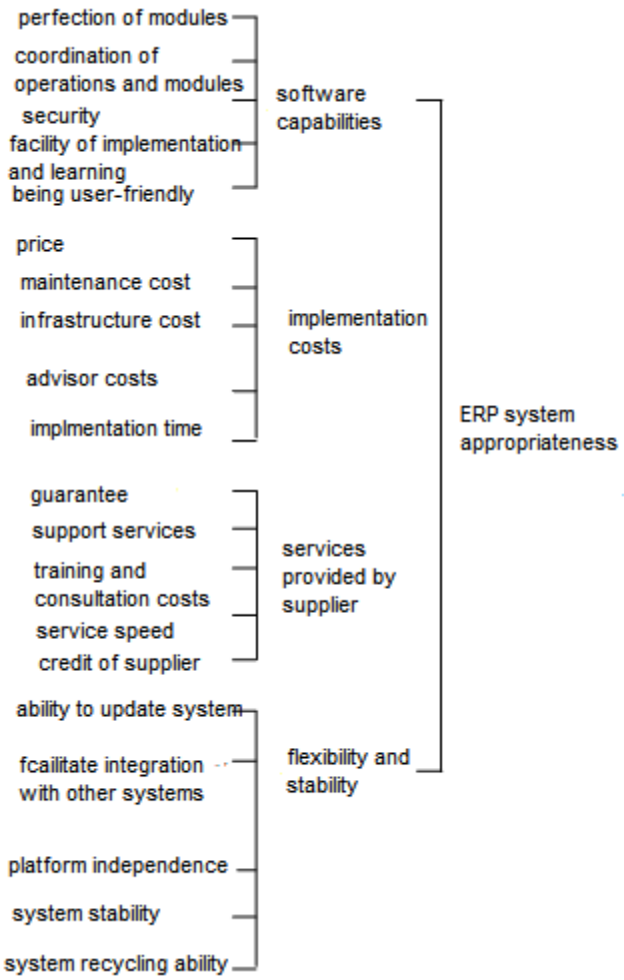


*Figure 1.* selection indices of an ERP system

## 3. Methodology of research

Statistical population in this study consists of experts of active companies in field of consultation and implementation of ERP in Tehran. Sampling method in this study is judgmental sampling. 20 consultation companies in field of consultation and implementation of ERP are selected as samples after search through Iran's High Council of Informatics. After going to companies and identifying the experts, 67 questionnaires were distributed and 38 questionnaires were collected. In second step of the study, to determine weight of the criteria used AHP method. This study is an applied research and is a descriptive research in terms of methodology. The data collection is done using two library and questionnaire methods through considering needs of the enterprise. Validity of questionnaire is measured through studying theoretical framework and using opinions of professors and experts in this field and the reliability of research instrument is measured using Cronbach's alpha and is obtained to 0.928.

*Table 1*. Results of reliability of each index to select ERP system

| Variable | Cronbach's alpha |
|---|---|
| Flexibility | 0.8 |
| Service | 0.796 |
| Cost | 0.836 |
| Software capabilities | 0.816 |

In order to answer research questions and to confirm research hypotheses, statistical methods are used and in second step of the research, AHP method is used to select appropriate software system for weighting and then, FVIKOR technique is used to select appropriate ERP system for the studied company. Applied questionnaire in this study is a researcher-made questionnaire with 5-point likert scale. Hence, mean value of the studied population in the analysis process is considered to 3.

## 4. Results

In order to test normality of the data obtained from the study, Kolmogorov-Smirnov test and Shapiro Wilk's test are used. In this analysis, H0 and alternative hypothesis are defined as follows:

H0: data distribution is normal (19)

H1: data distribution is not normal (20)

The results obtained from the analysis are presented in table 2.

*Table 2.* Comparing distribution of values of components with normal distribution

| Component | Kolmogorov-Smirnov | | Shapiro-Wilk | |
|---|---|---|---|---|
| | Value | p-value | Value | p-value |
| Flexibility | 0.185 | 0.002 | 0.916 | 0.007 |
| Service | 0.143 | 0.048 | 0.948 | 0.076 |
| Cost | 0.222 | 0.000 | 0.93 | 0.021 |
| Software capabilities | 0.129 | 0.11 | 0.946 | 0.066 |
| ERP | 0.141 | 0.056 | 0.918 | 0.009 |

According to results obtained from K-S test, only the index of software capabilities with p-value of p≥0.05 is normal and other indices with p-value lower than 0.05 are not normal. Moreover, about the Shapiro-Wilk's test, only two factors of service and software capability with p-value of p≥0.05 are normal. Therefore, as all data used in the test are not normal, nonparametric tests are used to test the hypotheses and one-sample Wilcoxon singed-ranking test is also used for this purpose. The results obtained from Wilcoxon test to test the hypotheses at the confidence level of 95% are summarized for mean values > 3 in table 3.Testing statistical hypotheses is presented as follows and the claim of this research is in

$$H_0: \mu \leq 3 \quad (21)$$

$$H_1: \mu > 3 \quad (22)$$

*Table 3.* Results of Wilcoxon signed-ranking test

| Indices | Mean | SD | p-value | Test result |
|---|---|---|---|---|
| Flexibility | 3.69** | 0.818 | 0.00 | Confirmed |
| Service | 3.52** | 0.761 | 0.00 | Confirmed |
| Cost | 3.31* | 0.821 | 0.028 | Confirmed |
| Software capabilities | 3.88** | 0.815 | 0.00 | Confirmed |

According to table 3, all indices have been significant at the level of p≤0.05. In other words, mean value of flexibility, service, cost and software capabilities with the probability of 95% are higher than average level. Hence, hypotheses are confirmed. In order to achieve significance of each effective index in the project of selecting the best ERP system, AHP method is used .The results of this analysis are presented in tables 4 and 5.

*Table 4.* AHP analysis results for main criteria

| Main criteria | Software capabilities | Flexibility | Cost | Service | Inconsistency rate |
|---|---|---|---|---|---|
| Weight | 0.565009 | 0.262201 | 0.055285 | 0.117504 | 0.04381 |
| Rank | 1 | 2 | 4 | 3 | |

*Table 5.* Relative weights calculated for sub-criteria of each main criterion of the project

| Main criteria | Sub-criteria | Weight | Inconsistency rate |
|---|---|---|---|
| Flexibility | Ability to update system | 0.298823 | 0.00879 |
| | Facility of integration | 0.298823 | |
| | Platform independence | 0.159684 | |
| | Stability | 0.13914 | |
| | Recycling ability | 0.10353 | |
| Software capabilities | Perfection of modules | 0.319185 | 0.00812 |
| | Coordination of operations | 0.319185 | |
| | Security | 0.184006 | |
| | Facility of implementation | 0.109344 | |
| | Being user-friendly | 0.068279 | |
| Service | Guarantee | 0.375999 | 0.00739 |
| | Providing support services | 0.214667 | |
| | Consultation services | 0.214667 | |
| | Service speed | 0.073778 | |
| | Training services | 0.120888 | |
| Cost | Price | 0.375999 | 0.00739 |
| | Maintenance costs | 0.214667 | |
| | Infrastructure costs | 0.214667 | |
| | Advisor costs | 0.073778 | |
| | Implementation time | 0.120888 | |

As the inconsistency rate obtained for the comparisons is below 0.1, the comparisons are consistent and reliable. According to the table 5, software capabilities has possessed rank 1 and the highest weighted load and flexibility, service and cost have respectively gained lowest weights.

After determining weighted load of criteria, to select the best system, Fuzzy VIKOR method is used. Before formation of decision matrix, the first step is to determine linguistic variables.

Linguistic terms are qualitative words of a natural language reflecting attitude of an expert about the factor in each studied index. The linguistic terms are then changed into fuzzy numbers.

*Table 6.* Fuzzy numbers corresponding to verbal words

| Linguistic term | Fuzzy number |
|---|---|
| Very weak | (1, 1, 1) |
| Weak | (2, 3, 4) |
| Average | (4, 5, 6) |
| Good | (6, 7, 8) |
| Very good | (8, 9, 9) |

*Table 7.* Fuzzy values for measurement of options (decision making matrix)

| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 | C17 | C18 | C19 | C20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Criterion | Positive | Positive | Positive | Positive | Positive | Positive | Positive | Positive | Positive | Positive | Negative | Negative | Negative | Negative | Negative | Positive | Positive | Positive | Positive | Positive |
| A1 | (6.167,7.167,8.083) | (6.5,7.5,8.25) | (6.167,7.167,8.083) | (6.667,7.667,8.333) | (6.167,7.167,8.083) | (6.333,7.333,8.167) | (5.5,6.5,7.5) | (6.167,7.167,8.083) | (6.333,7.333,8.167) | (6.667,7.667,8.333) | (7.167,8.167,8.583) | (6.333,7.333,8.167) | (6.333,7.333,8.167) | (6,7,7.917) | (6.5,7.5,8.25) | (7.5,8.5,8.75) | (7,8,8.5) | (6.167,7.167,8.083) | (6,7,8) | (5.667,6.667,7.667) |
| A2 | (6.333,7.333,8.167) | (7,8,8.5) | (8,9,9) | (6.333,7.333,8.167) | (6.333,7.333,8.167) | (6.833,7.833,8.417) | (6,7,8) | (6.167,7.167,8.083) | (7.333,8.333,8.667) | (6.833,7.833,8.417) | (7.5,8.5,8.75) | (6.667,7.667,8.333) | (6.5,7.5,8.25) | (6.333,7.333,8.167) | (6.667,7.667,8.333) | (7.833,8.833,8.917) | (7.333,8.333,8.667) | (6.5,7.5,8.25) | (6.333,7.333,8.167) | (6.5,7.5,8.25) |
| A3 | (7.5,8.5,8.75) | (7.833,8.833,8.917) | (7.833,8.833,8.917) | (7.667,8.667,8.833) | (7.5,8.5,8.75) | (7.833,8.833,8.917) | (6.667,7.667,8.333) | (8,9,9) | (7.833,8.833,8.917) | (7.5,8.5,8.75) | (7.5,8.5,8.75) | (7.333,8.333,8.667) | (7,8,8.5) | (7,8,8.5) | (7.5,8.5,8.75) | (8,9,9) | (8,9,9) | (7.667,8.667,8.833) | (7.833,8.833,8.917) | (7.5,8.5,8.75) |
| A4 | (6.333,7.333,8.167) | (7.333,8.333,8.667) | (8,9,9) | (7.5,8.5,8.75) | (7.833,8.833,8.917) | (7.167,8.167,8.583) | (6,7,8) | (7.833,8.833,8.917) | (7.667,8.667,8.833) | (7.667,8.667,8.833) | (5.5,6.5,7.5) | (6.167,7.167,8.083) | (6.167,7.167,8.083) | (6.667,7.667,8.333) | (7.167,8.167,8.583) | (7.333,8.333,8.667) | (7.333,8.333,8.667) | (7,8,8.5) | (6.833,7.833,8.417) | (6.333,7.333,8.167) |
| Weight of criteria | (0.18,0.18,0.18) | (0.18,0.18,0.18) | (0.104,0.104,0.104) | (0.062,0.062,0.062) | (0.039,0.039,0.039) | (0.078,0.078,0.078) | (0.078,0.078,0.078) | (0.042,0.042,0.042) | (0.036,0.036,0.036) | (0.027,0.027,0.027) | (0.021,0.021,0.021) | (0.012,0.012,0.012) | (0.012,0.012,0.012) | (0.004,0.004,0.004) | (0.007,0.007,0.007) | (0.044,0.044,0.044) | (0.025,0.025,0.025) | (0.025,0.025,0.025) | (0.009,0.009,0.009) | (0.014,0.014,0.014) |

*Table 8.* Decision making unscaled table (normalized)

| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 | C17 | C18 | C19 | C20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | (-0.226,0.516,1) | (-0.172,0.552,1) | (-0.029,0.647,1) | (-0.267,0.4,0.867) | (-0.091,0.606,1) | (-0.129,0.581,1) | (-0.294,0.412,1) | (-0.029,0.647,1) | (-0.129,0.581,1) | (-0.308,0.462,1) | (-0.103,0.513,0.949) | (-0.7,0.067,0.8) | (-0.75,0.071,0.857) | (-0.767,0,0.767) | (-0.778,0,0.778) | (-0.45,0.3,0.9) | (-0.25,0.5,1) | (-0.156,0.563,1) | (-0.057,0.629,1) | (-0.054,0.595,1) |
| A2 | (-0.258,0.452,0.935) | (-0.276,0.345,0.793) | (-0.353,0,0.353) | (-0.2,0.533,1) | (-0.121,0.545,0.939) | (-0.226,0.387,0.806) | (-0.471,0.235,0.824) | (-0.029,0.647,1) | (-0.323,0.194,0.613) | (-0.346,0.385,0.923) | (0,0.615,1) | (-0.567,0.2,0.867) | (-0.679,0.143,0.893) | (-0.633,0.133,0.867) | (-0.704,0.074,0.815) | (-0.55,0.1,0.7) | (-0.333,0.333,0.833) | (-0.219,0.438,0.875) | (-0.114,0.514,0.886) | (-0.243,0.324,0.73) |
| A3 | (-0.484,0,0.484) | (-0.448,0,0.448) | (-0.324,0.059,0.412) | (-0.467,0,0.467) | (-0.333,0.121,0.515) | (-0.419,0,0.419) | (-0.588,0,0.588) | (-0.353,0,0.353) | (-0.419,0,0.419) | (-0.5,0.077,0.615) | (0,0.615,1) | (-0.3,0.467,1) | (-0.464,0.357,1) | (-0.367,0.4,1) | (-0.333,0.444,1) | (-0.6,0,0.6) | (-0.5,0,0.5) | (-0.438,0,0.438) | (-0.371,0,0.371) | (-0.405,0,0.405) |
| A4 | (-0.258,0.452,0.935) | (-0.345,0.207,0.655) | (-0.353,0,0.353) | (-0.433,0.067,0.533) | (-0.394,0,0.394) | (-0.29,0.258,0.677) | (-0.471,0.235,0.824) | (-0.324,0.059,0.412) | (-0.387,0.065,0.484) | (-0.538,0,0.538) | (-0.615,0,0.615) | (-0.767,0,0.767) | (-0.821,0,0.821) | (-0.5,0.267,0.933) | (-0.481,0.296,0.926) | (-0.4,0.4,1) | (-0.333,0.333,0.833) | (-0.313,0.25,0.688) | (-0.2,0.343,0.714) | (-0.216,0.378,0.784) |

Table 9 has presented fuzzy values and crisp values of S, R and Q.

*Table 9*. S, R and Q values

| | S | Sg | R | Rg | Q | Qg |
|---|---|---|---|---|---|---|
| A1 | (-0.201,0.513,0.98) | 0.451 | (0,0.099,0.18) | 0.095 | (-0.488,0.405,1) | 0.33 |
| A2 | (-0.292,0.342,0.806) | 0.3 | (0,0.081,0.169) | 0.083 | (-0.519,0.295,0.907) | 0.244 |
| A3 | (-0.438,0.04,0.5) | 0.035 | (0,0.013,0.087) | 0.028 | (-0.57,0,0.575) | 0.001 |
| A4 | (-0.365,0.21,0.68) | 0.184 | (-0.002,0.081,0.169) | 0.082 | (-0.549,0.249,0.862) | 0.203 |

As conditions 1 and 2 are provided, final ranking is presented in table 8.

*Table 10.* Final ranking

| Options |
|---|
| A3 |
| A4 |
| A2 |
| A1 |

## 5. Discussions and conclusions

Implementation of a successful enterprise resource planning (ERP) system within the organization in consistence with organizational needs and status is very important and it is necessary for business managers to analyze these systems carefully and consider advantages and disadvantages of type of products and domestic and foreign software systems to compare them and choose the product with highest consistency with enterprise status. According to importance of development of information systems and integration of information and increasing promotion of ERP within the organizations, various articles have been conducted in this field and each of them have been investigated using different approach. This study has provided a comprehensive framework to choose the best and the most appropriate ERP system based on AHP and FVIKOR technique. This method helps the scholars to identify main indices to choose an appropriate ERP system and to measure the effect of each index on ERP system function. To have a successful ERP system, effective indices are firstly identified and after adjusting them with corporate conditions, final indices are extracted and the best system is selected using FVIKOR test. This study helps experts to identify enterprise needs and make sure that the indices are adjusted with the organizational goals and strategies. On the other hand, they could understand the effect of each index on evaluation and successful implementation of an ERP system. Moreover, using this method, the experts could consider different evaluations of each company about effect of the indices on each system and provide a unit conclusion of final evaluation of each studied company and finally, this study helps the scholars achieve a comprehensive framework to make decision about choosing an appropriate ERP system. The results obtained from this study show that indices including software capabilities, costs of implementation, services supplied by the supplier and flexibility and stability of system are effective indices to choose ERP system. Hence, hypotheses 1-4 are confirmed. About the first research question, the results obtained from study show that software capability, flexibility, service and costs are effective factors and have possessed respectively lowest impact factor in field of choosing appropriate ERP system. About second research question, the results obtained from FVIKOR test show that software system of EPICOR is the best ERP system for the studied company.

Therefore, the suggestion of this study for business managers to implement an ERP system is to identify key factors of gaining a successful ERP system leading to cost and time reduction and enhancement of speed at the first. Then, they should analyze different software systems of ERP system and try to use the best and the most cost-effective system with the help of experts and due to needs of their companies, so that they can face lowest surplus costs such as purchase of software, implementation cost, support and repair costs and could save time and money.

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