Australian Journal of Basic and Applied Sciences, 6(9): 251-263, 2012
ISSN 1991-8178

Comparison Of Multiple Criterion Decision Making Methods For Evaluation Parsian Banks E-Readiness For ECRM Implementation

[1]Fereshteh Abbas Azimi, [2]Ali Akbar Jalali, [3]Ahmad Farahi

[1]Information and Technology management college, Payame noor university,Tehran, Iran.
[2]Electrical Engineering, University of Science and Technology,Tehran, Iran
[3]Technical & engineering college, Payame noor University, Tehran, Iran

Abstract: The Evaluation of eCRM implementation in most of organizations will witness an increase in efficiency, staff satisfaction, and eventually customer satisfaction. The objective of this paper is to apply and compare the analytic hierarchy process (AHP), Fuzzy AHP and Fuzzy Topsis methods to evaluate the Parsian banks' readiness in ECRM implementation. Primary data have been collected by means of questionnaires and the effective factors have been classified using the statistical analysis with the SPSS software. Then, these factors were ranked using AHP, Fuzzy-AHP and Fuzzy-Topsis methods.

Key words: E-CRM, Analytical Hierarchy Process(AHP), Fuzzy-AHP and Fuzzy-Topsis

INTRODUCTION

Customer relationship management(CRM) has been introduce to most organizations as some kind of innovation plan and is of particular priority. Customer relationship management is a business strategy for creating the two-way value which identifies customers' whole particulars, generates customers' knowledge, and develops relationship with customers and leads to their understanding of the organizational products or service. Thus, examining such an invaluable concept in banks whose business is based on customers is highly essential.

Numerous models have been put forward to assessing the level of organizational preparedness for applying this technique. The model proposed by Ocker and Mudambi (2002), developed in terms of three theoretical, social and technological dimensions that the theoretical (intellectual) dimension comprises strategy, structure and planning groups, the social dimension is composed of culture, stakeholder interaction, and knowledge of work field groups, and finally, the technological dimensions consists of CRM applied plan, IT capabilities, and knowledge management groups. New organizations find them gradually developing as customer-oriented organizations and realize that they have achieved new opportunities to make profit by successfully implementing the E-CRM plans.

Kodwel has introduced customer relationship management as an integration of sale, marketing and service strategies, regarding it as a factor for hampering creation of a one-dimensional view of customers, and points to the role of integration of different processes and departments in implementing CRM with the purpose of increasing the service provided to customers (Hamand, 2010). Adam Lyndgryn *et al*., (2006) consider nine factors to be essential for CRM success: customer strategy, customer interaction strategy, value creation strategy, culture, individuals, organizational structure, IT, process, knowledge management and learning. Broadly speaking, ECRM has four principal merits: increased customer loyalty, effective marketing, improved service, systematic logistics, and increased productivity and reduced costs (Ahmed, 2009). ECRM is basically meant to understand values and best treat customers so as to heighten their loyalty and naturally corporate profitability.

Increasing customer profitability; establishing communication and information channels; improving productivity; developing sharing information with customers; promoting customer-orientation culture; identifying customers' important needs; process re-engineering; CRM project planning; customers' exclusive cooperation with the institute; identifying key customers; attracting important customers; developing sale; controlling product quality; improving after-sales service; suitable, competitive price; creating databanks for customers; promoting customer-orientation culture in organization; appropriate cooperation with the organization's internal divisions appropriately are key success factors for implementing CRM (Mohammad Almoutiri, 2008; Paul Harigan, 2010).Others like Alen Kennedy (2006) points out the online communication management; IT;establishment of communication channels are key factors for ECRM. Customer selection; customer attraction; customer maintenance; customer development are important factors for ECRM implementation. (Ahmed, 2009). AHP, has been widely used in solving many complicated decision-making problems (Chan, Kumar, Tiwari, Lau, & Choy,2007; Dagˇdeviren & Yuksel, 2008). The extent fuzzy AHP is utilized, which was originally introduced by Chang, (1996). The TOPSIS method was firstly proposed by Hwang and Yoon (1981).

Corresponding Author: Fereshteh Abbas Azimi, Information and Technology management college,Payame noor university,Tehran, Iran.
E-mail: azimif@iust.ac.ir, feriazimi@yahoo.com

There are many applications of Fuzzy AHP, Fuzzy Topsis in the literature. For instance, The fuzzy APH has been applied in a variety of computer science and information technology areas in literature for evaluating and selecting, e.g., the product of notebook computers (Srichetta & Thurachon, 2011). Chatterjeef *et al*. (2010) show AHP helps the decision makers to deal with imprecision and subjective-ness in pair-wise comparison process in the ranking of Indian banks. Chen, (2000) extended the TOPSIS to the fuzzy environment and gave a numerical example of system analysis engineer selection for a software company. Tsaur *et al*., (2002) applied fuzzy set theory to evaluate the service quality of airline. Chu (2002) presented a fuzzy TOPSIS model under group decisions for solving the facility location selection problem. The article by Torlak *et al*. (2011) uses fuzzy TOPSIS multi-methodological approach in the Turkish domestic airline industry. It starts by describing exceedingly complex nature of competition in the sector. Then, it deals with the constituent parts of the research methodology and the eclectic approach itself. Chu and Lin (2003) proposed the fuzzy TOPSIS method for robot selection. Abo-Sinna and Amer (2005) extended the TOPSIS approach to solve the multi-objective large-scale nonlinear programming problems with block angular structure. Sadi nejad and Khalili (2009) proposed a fuzzy TOPSIS method based on modified preference ratio and fuzzy distance measurement in assessment of traffic police centers performance. Jahanshahloo *et al*.,(2006) extended the TOPSIS method to decision-making problems with fuzzy data and they used the concept of α-cuts to normalize fuzzy numbers. The aim of study by Yalcın Secme *et al*. (2009) is to propose a fuzzy multi-criteria decision model to evaluate the performances of banks. Fuzzy Analytic Hierarchy Process (FAHP) and Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) methods are integrated in the proposed model. Chen *et al*., (2006) presented a fuzzy TOPSIS approach to deal with the supplier selection problem in supply chain system. Wang and Wang (2007) developed an evaluation approach based on the fuzzy TOPSIS to help the Air Force Academy in Taiwan to choose initial training aircraft. Benitez *et al*., (2007) presented a fuzzy TOPSIS method for measuring quality of service in the hotel industry. Wang and Lee (2007) generalized TOPSIS to fuzzy multiple-criteria group decision-making in a fuzzy environment. They proposed two operators Up and Lo that are employed to find ideal and negative ideal solutions.

Parsian Bank is treated as a facile organization wherein new changes and strategies have emerged faster and with more development in comparison to other banks.

This paper develops an evaluation ecrm implementation in private banks (Parsian Banks) based on the analytic hierarchy process (AHP) and the technique for order performance by similarity to ideal solution (TOPSIS), for the selection of optimal factors for ecrm implementation in bank in a fuzzy environment where the vagueness and subjectivity are handled with linguistic values parameterized by triangular fuzzy numbers.

The remainder of this study is structured as follows: After the questionnaire were distributed among the bank’s managers and employes. The researcher-developed questionnaires were adopted for data collection. Questionnaire, comprising 37 closed items, divided into items on effective factors in the level of bank's readiness to administer the customer relationship management and another items regarding CRM principles. Each effective factor accounts for several items. In statistical computation, these items are integrated and measure one factor. In next sections the first briefly describes the theorical proposed methods and How the proposed model is used on a real example in order to compare and rank ECRM indices in Parsian Bank is explained . In final Section,conclusions and suggestions are discussed.

Ranking ECRM Primary Factors:

In order to determine item reliability, Cronbach α coefficient, and SPSS software were applied, and α value was extracted as follows for each variable included in the questionnaire. Finally, item reliability was verified. Computation of Cronbach α coefficient for the whole questionnaire is shown in Table 1.

Table 1: Determination Cronbach α coefficient in SPSS software

No.	Variable	Questionnaire Item(s)	Cronbach α
1	Bank’s strategies	6	0.716
2	Structures and processes	7	0.808
3	Planning and practical plans	5	0.715
4	Organizational culture	3	0.722
5	Stakeholders interaction	3	0.713
6	Knowledge and work field	3	0.755
7	IT Capabilities	4	0.773
8	Readiness for implementation	6	0.777

Seven primary hypotheses have been formulated in this study such as below:

- There is a significant relation between the bank's strategies and readiness for implementing ECRM
- There is a significant relation between structures, processes and readiness for implementing ECRM.
- There is a significant relation between the organizational culture and readiness for implementing ECRM
- There exists a significant relation between planning and practical plans and readiness for implementing ECRM
- There exists a significant relation between IT Capabilities and readiness for implementing ECRM
- There is a significant relation between Stakeholders interaction and readiness for implementing ECRM.
- There exists a significant relation between knowledge management and readiness for implementing ECRM.

in order to examine the relation between variables, in order to these hypotheses, Spearman Correlation Coefficient test were applied as to expolore the relation between independent and dependent variables.

In this part, seven hypotheses were investigated in order to assess and measure the level of Parsian bank's readiness for implementing ECRM. Based on the research results, the correlation coefficient between the effective factors in the level of bank's readiness for implementing the customer relationship management was summarized as Table2.

Table 2: The correlation coefficient between the effective factors in the level of bank's readiness and implementing ECRM

No.	Variable	Correlation Coefficient
1	Bank's strategies	0.683
2	Structures and processes	0.352
3	Organizational culture	0.546
4	Planning and practical plans	0.721
5	IT capabilities	0.715
6	Stakeholders interaction	0.270
7	Knowledge management	0.454

Methods:

3.1. Ranking Different Dimensions Of Implementing CRM Systems With AHP Model:

Analytic Hierarchy Process (AHP), proposed by Saaty (Saaty, 1980), is a traditional powerful decision-making methodology in order to determine the priorities among

different criteria, comparing alternatives for each criterion, and determining an overall ranking of the alternatives. The final outcome of the AHP is the best choice among decision alternatives. The basic procedure to carry out the AHP consists of the following steps:

1)Decomposing the decision problem into a hierarchy. The top level of the hierarchy represents the overall goal of the decision problem, the intermediate levels represent the criteria and sub-criteria affecting the decision, and the bottom level represents the possible alternatives. 2) Calculating the relative importance weights of decision criteria in each level of the hierarchy using pair-wise comparisons. In this step, the decision maker uses the fundamental scale or weight between 1 (equal importance) and 9 (extreme importance) defined by Saaty to assess the priority score for each pair of criteria in the same level (Table 3),. That is, the pair-wise comparison matrix is constructed in which the elements *aij* inside the matrix can be interpreted as the degree of the precedence of the *i*th criterion over the *j*th criterion (Table 4). Then, the average weight for each normalized criterion is computed. 3) Evaluating the decision alternatives taking into account the weights of decision criteria. The alternative scores are combined with the criterion weights to produce an overall score for each alternative. (Phanarut, 2012)..

Table 3. Nine-point intensity of importance scale and its description

Index	S1	S2	S3	S4	S5	S6	S7
S1	1	1.18	2.44	1.23	0.89	1.8	2.54
S2	0.85	1	1.44	1	0.78	1.12	1.97
S3	0.41	0.69	1	0.28	0.19	0.36	0.98
S4	0.81	1	3.57	1	0.82	1.22	2.12
S5	1.12	1.28	5.26	1.22	1	1.19	1.14
S6	0.56	0.89	2.78	0.82	0.84	1	0.28
S7	0.39	0.51	1.02	0.47	0.88	3.57	1

Table 4: Compared indices according to department

Definition	Intensity of importance
Equally important	1
Moderately more important	3
Strongly more important	5
Very strongly more important	7
Extremely more important	9
Intermediate values	2, 4, 6, 8

S_1: Bank's strategy;
S_2: structures and processes;
S_3: organizational culture;
S_4: planning and practical plans;
S_5: IT Capabilities;
S_6: Stakeholders interaction;
S_7: knowledge management.

After entering the data in Expert choice software, the following result is obtained (Fig. 1)

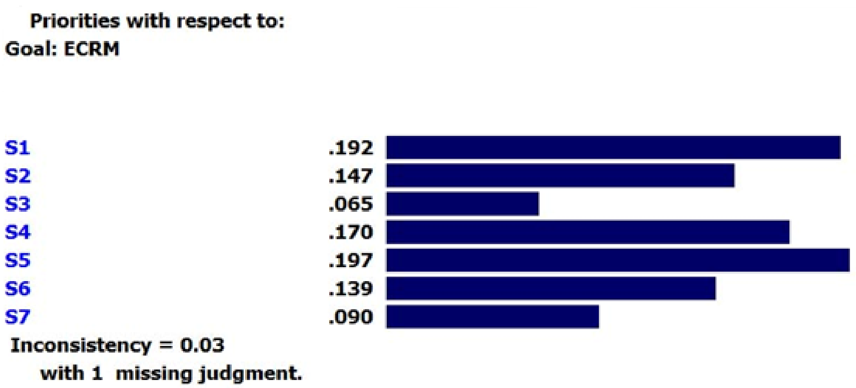

Fig. 1: Prioritize criteria using Expert Choice software

The result is summarized in Table 5.

Table 5: overall score for each alternative

Index	Importance Level
S_5	0.197
S_1	0.192
S_4	0.170
S_2	0.147
S_7	0.139
S_6	0.090
S_3	0.065

Therefore, based on AHP method, the indices chosen by this method are prioritized as below:
1. S_5: IT Capabilities
2. S_1: Bank's strategy
3. S_4: Planning and practical plans
4. S_2: Structures and processes
5. S_7: Knowledge management
6. S_6: Interaction with stakeholders
7. S_3: Organizational culture

Finally, the compatibility rate "C.R" is derived from the following formula:
C.R = C.I/R.I

In this study, C.R. was achieved at 0.07, and since this amount is less than 0.1, it can be said that the estimated mean is significant.

3.2. Ranking based on FAHP (Fuzzy-AHP) method:

The conventional AHP is inadequate for dealing with the imprecise or vague nature of linguistic assessment. In Fuzzy AHP, common sense linguistic statements have been used in the pair-wise comparison which can be represented by the triangular fuzzy numbers(Erensal *et al*., 2006; Iranmanesh *et al*., 2008). Afterwards, the step of aggregating the pair-wise comparison and the synthesis of the priorities to determine the overall priorities of the decision alternatives will be done.

3.2.1. Triangular Fuzzy Numbers (TFNs):

The TFNs used in the pair-wise comparison are defined by three real numbers expressed as a triple (l, m, u) where $l \leq m \leq u$ for describing a fuzzy event(Fig. 3)

3.2.2. Construct the Fuzzy Pair-Wise Comparison Matrix:

To construct the fuzzy judgment matrix Ã={ãij} of n criteria or alternatives via pair-wise comparison, the TFNs are used as follows(Phanarut *et al*., 2012; Erensal *et al*., 2006):

$$\tilde{A} = \begin{bmatrix} 1 & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \tilde{a}_{21} & 1 & \dots & \tilde{a}_{2n} \\ \dots & \dots & \dots & \dots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \dots & 1 \end{bmatrix} \tag{1}$$

where ãij is a fuzzy triangular number, ãij =(*lij*, *mij*, *uij*), and ãji = 1/ãij. For each TFN, ãij or $M = (l, m, u)$, its membership function $\mu_{\tilde{a}}(x)$ or $\mu_M(x)$ is a continuous mapping from real number $-\infty \leq x \leq \infty$ to the closed interval [0, 1] and can be defined by equation (1).

The operations on TFNs can be addition, multiplication, and inverse. Suppose *M1* and *M2* are TFNs where *M1*=(*l1, m1,u1*) and *M2*=(*l2, m2, u2*), then

Addition : $$M_1 \oplus M_2 = (l_1 + l_2, m_1 + m_2, u_1 + u_2) \tag{2}$$

Multiplication : $$M_1 \otimes M_2 = (l_1.l_2, m_1.m_2, u_1.u_2) \tag{3}$$

Inverse : $$M_1^{-1} = (l_1, m_1, u_1)^{-1} \approx (1/u_1, 1/m_1, 1/l_1) \tag{4}$$

3.2.3. Aggregate the Group Decisions:

After collecting the fuzzy judgment matrices from all decision makers, these matrices can be aggregated by using the fuzzy geometric mean method (c) The aggregated TFN of n decision makers' judgment in a certain case *ũij* = (*lij, mij, uij*) is:

$$\tilde{u}_{ij} = \left(\prod_{i=1}^{n} \tilde{a}_{ijk} \right)^{1/n} \tag{5}$$

where *C is* the relative importance in form of TFN of the k^{th} decision maker's view, and n is the total number of decision makers.

3.2.4. Compute the Value of Fuzzy Synthetic Extent:

Based on the aggregated pair-wise comparison matrix, *Ũ*={*ũij*}, the value of fuzzy synthetic extent *Si* with respect to the *ith* criterion can be computed by making use of the algebraic operations on TFNs as described in above.

$$S_i = \sum_{j=1}^{m} \tilde{u}_{ij} \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} \tilde{u}_{ij} \right]^{-1}$$

$$\text{where } \sum_{j=1}^{m} \tilde{u}_{ij} = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j \right) \text{ and} \tag{6}$$

$$\sum_{i=1}^{n} \sum_{j=1}^{m} \tilde{u}_{ij} = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i \right).$$

3.2.5. Approximate the Fuzzy Priorities:

Based on the fuzzy synthetic extent values, the non-fuzzy values that represent the relative preference or weight of one criterion over others are needed. Therefore, this paper firstly uses Chang's method (Phanarut Srichetta,2012) to find the degree of possibility that *Sb≥Sa* as follows:

$$V(S_b \geq S_a) = \begin{cases} 1 & , \quad if\ m_b \geq m_a \\ 0 & , \quad if\ l_a \geq u_b \\ \dfrac{l_a - u_b}{(m_b - u_b) - (m_a - l_a)}, & otherwise \end{cases} \qquad (7)$$

where *d* is the ordinate of the highest intersection between μ_{Sa} and μ_{Sb} as shown in Fig 2. That is, it can be expressed that:

$$V(S_b \geq S_a) = hight(S_a \cap S_b) = \mu_{S_a}(d) \qquad (8)$$

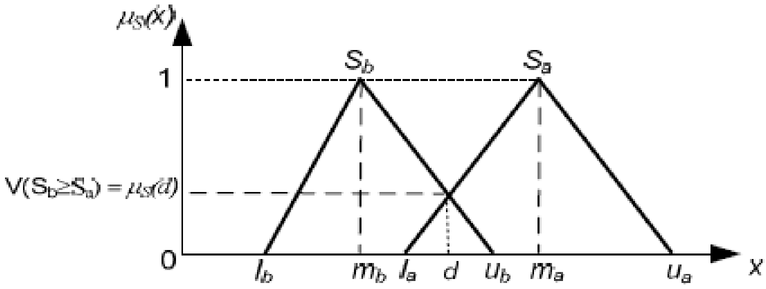

Fig. 2: The intersection between Sa and Sb and their degree of possibility

(Srichetta *et al*., (2012); Erensal *et al*., (2006))

It is noted that both values of $V(S_a \geq S_b)$ and $V(S_b \geq S_a)$ are required. The degree of possibility for a TFN *Si* to be greater than the number of *n* TFNs S_k can be given by the use of operation min (Phanarut Srichetta,2012):

$$V(S_i \geq S_1, S_2, \ldots \quad S_k) = \min \quad V(S_i \geq S_k) = \quad w'(S_i) \qquad (9)$$

where *k*= 1, 2, …, *n* and *k* # *i*, and *n* is the number of criteria described previously. Each *w′*(*S*) value represents the relative preference or weight, a non-fuzzy number, of one criterion over others. However, these weights have to be normalized in order to allow it to be analogous to weights defined from the AHP method. Then, the normalized weight *w*(*Si*) will be formed in terms of a weight vector as follows:

$$W = (w(S_1), w(S_2), \ldots, w(S_n))^T$$

Once the weights of criteria are evaluated, it is required to calculate the scores of alternatives with respect to each criterion and then determine the composite weights of the decision alternatives by aggregating the weights through hierarchy.

Once the linguistic variables were changed into fuzzy triangular numbers, the geometric means of the collected data was computed and the integrated fuzzy data were achieved(Table 6).

Table 6: Integrated fuzzy data for alternatives

Index	S1	S2	S3	S4	S5	S6	S7
S1	(1,1,1)	(1,1.18,3)	(3,2.44,4)	(0.33,1.23,4)	(.33,.89,1)	(.2,1.8,5)	(1,2.54,5)
S2	(.33,.85,1)	(1,1,1)	(1,1.44,3)	(0.50,1,2)	(.2,.78,2)	(.33,1.12,3)	(1,1.97,3)
S3	(.25,.41,.33)	(.33,.69,1)	(1,1,1)	(.14,.28,.50)	(.14,.19,.50)	(.14,.36,3)	(.11,.98,2)
S4	(.25,.81,3.03)	(.50,1,2)	(2,3.57,7.14)	(1,1,1)	(.50,.82,1)	(.33,1.22,3)	(.16,2.12,3)
S5	(1,1.12,3.03)	(.50,1.28,5)	(2,5.26,7.14)	(1,1.22,2)	(1,1,1)	(1,1.19,2)	(1,1.14,2)
S6	(.2,.56,5)	(.33,.89,3.03)	(.33,2.78,7.14)	(.33,.82,3.03)	(.50,.84,1)	(1,1,1)	(.14,.28,1)
S7	(.2,.39,1)	(.33,.51,1)	(.5,1.02,9.09)	(.33,.47,6.25)	(.50,.88,1)	(1,3.57,7.14)	(1,1,1)

S_1: Bank's strategy; S_2: structures and processes; S_3: organizational culture; S_4: planning and practical plans; S_5: IT capabilies; S_6: Stakeholders interaction; S_7: knowledge management.

-Computing S_i vector:

This vector is computed through multiplication of two vectors as follows: in order to attain the first vector, fuzzy number components in each row are added.

The second vector is derived from addition of the entire triangular numbers in the above matrix, which been reversed. This vector is the same in computing the entire S_I.

Reverse of a triangular number will be achieved in the following manner: if we take a_{ij} = (l, m, u) a fuzzy triangular number, its reverse will be as follows: a_{ij}^{-1} = (1/u,1/m,1/l).

$$S_1 = (6.86,11.08,23.00) \otimes (\frac{1}{32.28},\frac{1}{49.84},\frac{1}{136.37}) = (0.05,0.22,0.71)$$

$$S_2 = (4.36,8.16,15.00) \otimes (\frac{1}{32.28},\frac{1}{49.84},\frac{1}{136.37}) = (0.03,0.16,0.46)$$

$$S_3 = (2.11,3.91,8.33) \otimes (\frac{1}{32.28},\frac{1}{49.84},\frac{1}{136.37}) = (0.02,0.08,0.26)$$

$$S_4 = (4.74,10.54,20.17) \otimes (\frac{1}{32.28},\frac{1}{49.84},\frac{1}{136.37}) = (0.03,0.21,0.62)$$

$$S_5 = (7.50,12.22,22.17) \otimes (\frac{1}{32.28},\frac{1}{49.84},\frac{1}{136.37}) = (0.05,0.25,0.69)$$

$$S6 = (2.84,7.17,21.20) \otimes (\frac{1}{32.28},\frac{1}{49.84},\frac{1}{136.37}) = (0.02,0.14,0.66)$$

$$S7 = (3.87,7.84,26.48) \otimes (\frac{1}{32.28},\frac{1}{49.84},\frac{1}{136.37}) = (0.03,0.16,0.82)$$

S_i vectors will be compared by means of the following formula in the fuzzy hierarchical analysis algorithm:

$$V(S_1 \geq S_2) = 1 .... if S_1 \geq S_2$$

$$V(S_1 \geq S_2) = \frac{l_2 - u_1}{(m_1 - u_1) - (m_2 - u_2)} .... if S_2 \geq S_1 \quad (8)$$

$$S_1 = (l_1, m_1, u_1)$$
$$S_2 = (l_2, m_2, u_2)$$

Therefore, given the above formula, S_1 to S_7 vectors will be compared as Table 7.

Table 7: Compared S_i vectors

s	$i = 1$	$i = 2$	$i = 3$	$i = 4$	$i = 5$	$i = 6$	$i = 7$
$V(S_i \geq S_1)$	-	0.88	0.59	0.98	1	0.89	0.92
$V(S_i \geq S_2)$	1	-	0.73	1	1	0.97	0.99
$V(S_i \geq S_3)$	1	1	-	1	1	1	1
$V(S_i \geq S_4)$	1	0.90	0.63	-	1	0.90	0.94
$V(S_i \geq S_5)$	0.97	0.83	0.55	0.94	-	0.86	0.90
$V(S_i \geq S_6)$	1	1	0.78	1	1	-	1
$V(S_i \geq S_7)$	1	1	0.74	1	1	0.98	-

In the next step, the amounts of d(I)s are formed as follows:

$$d'(I1) = MIN(S_1 \geq S_2, S_3, S_4, S_5, S_6, S_7) = MIN(1,1,1,0.97,1,1) = 0.97$$
$$d'(I2) = MIN(S_2 \geq S_1, S_3, S_4, S_5, S_6, S_7) = MIN(0.88,1,0.90,0.83,1,1) = 0.83$$
$$d'(I3) = MIN(S_3 \geq S_1, S_2, S_4, S_5, S_6, S_7) = MIN(0.59,0.73,0.63,0.55,0.78,0.74) = 0.55$$
$$d'(I4) = MIN(S_4 \geq S_1, S_2, S_3, S_5, S_6, S_7) = MIN(0.98,1,1,0.94,1,1) = 0.94$$
$$d'(I5) = MIN(S_5 \geq S_1, S_2, S_3, S_4, S_6, S_7) = MIN(1,1,1,1,1,1) = 1$$
$$d(I6) = MIN(S_6 \geq S_1, S_2, S_3, S_4, S_5, S_7) = MIN(0.89,0.97,1,0.90,0.86,0.98) = 0.86$$
$$d(I7) = MIN(S7 \geq S_1, S_2, S_3, S_4, S_5, S_6) = MIN(0.92,0.99,1,0.94,0.90,1) = 0.90$$

$$W' = (0.97, 0.83, 0.55, 0.94, 1, 0.86, 0.90)^T$$

As a result, based on FAHP method, the criteria will be prioritized as Table 8.

Table 8: Alternatives ranking using FAHP

indices	Importance Level
S_1	0.16
S_2	0.14
S_3	0.09
S_4	0.16
S_5	0.17
S_6	0.15
S_7	0.10

Therefore, based on Fuzzy-AHP method, the indices chosen by this method are prioritized as below:
S_5: IT Capabilities;
S_1: Bank's strategy;
S_4: planning and practical plans;
S_6: Stakeholders interaction;
S_2: structures and processes;
S_7: knowledge management.
S_3: organizational culture

3.3. Ranking of Different Dimensions of Implementing ECRM Systems with Fuzzy Topsis Model:

6 steps of the Fuzzy Topsis method were implemented as follows in order to rank different dimensions of implementing ECRM systems(Shih *et al*., 2007; Wang *et al*., 2007)

Step 1:Choose the linguistic values for alternatives with respect to criteria.
Forming data matrix based on 20 respondents and 7 dimensions is shown as Table 9.

Table 9: Fuzzy evaluation matrix for the alternatives(s1 to s7)

Index	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20
s1	(3,5,7)	(1,1,3)	(7,9,9)	(1,1,3)	(3,5,7)	(5,7,9)	(3,5,7)	(3,5,7)	(7,9,9)	(3,5,7)	(7,9,9)	(5,7,9)	(7,9,9)	(5,7,9)	(3,5,7)	(7,9,9)	(7,9,9)	(3,5,7)	(3,5,7)	(1,3,5)
S2	(1 ,3,5)	(1,3,5)	(7,9,9)	(3,5,7)	(5,7,9)	(3,5,7)	(5,7,9)	(1,3,5)	(7,9,9)	(1,3,5)	(5,7,9)	(3,5,7)	(3,5,7)	(3,5,7)	(3,5,7)	(3,5,7)	(3,5,7)	(5,7,9)	(1,3,5)	(1,1,3)
S3	(7,9,9)	(3,5,7)	(3,5,7)	(1,3,5)	(3,5,7)	(5,7,9)	(1,3,5)	(3,5,7)	(5,7,9)	(3,5,7)	(3,5,7)	(1,3,5)	(5,7,9)	(5,7,9)	(5,7,9)	(5,7,9)	(5,7,9)	(3,5,7)	(1,1,3)	(1,1,3)
S4	(5,7,9)	(7,9,9)	(7,9,9)	(5,7,9)	(5,7,9)	(1,3,5)	(5,7,9)	(1,3,5)	(7,9,9)	(1,3,5)	(5,7,9)	(5,7,9)	(7,9,9)	(7,9,9)	(3,5,7)	(1,3,5)	(1,3,59)	(3,5,7)	(5,7,9)	(1,1,3)

S5	(3,5,7)	(5,7,9)	(1,3,5)	(3,5,7)	(3,5,7)	(5,7,9)	(3,5,7)	(1,1,3)	(5,7,9)	(3,5,7)	(3,5,7)	(3,5,7)	(5,7,9)	(3,5,7)	(5,7,9)	(5,7,9)	(3,5,7)	(1,3,5)	(7,9,9)	(1,1,3)
S6	(1,3,5)	(3,5,7)	(1,3,5)	(7,9,9)	(3,5,7)	(3,5,7)	(1,3,5)	(1,3,5)	(7,9,9)	(3,5,7)	(1,3,5)	(5,7,9)	(5,7,9)	(5,7,9)	(3,5,7)	(3,5,7)	(5,7,9)	(3,5,7)	(3,5,7)	(3,5,7)
S7	(1,1,3)	(7,9,9)	(5,7,9)	(1,3,5)	(3,5,7)	(5,7,9)	(1,1,3)	(3,5,7)	(3,5,7)	(5,7,9)	(1,3,5)	(3,5,7)	(5,7,9)	(1,3,5)	(3,5,7)	(1,3,5)	(3,5,7)	(7,9,9)	(1,3,5)	(3,5,7)

Step 2: the following formula was used for data standardization:

$$\widetilde{r_{ij}} = \begin{cases} \left(\frac{a_{ij}}{c_j}, \frac{b_{ij}}{b_j}, \frac{c_{ij}}{a_j}\right); i = 1,2,\dots,m, j \in B \\ \left(\frac{a_j^-}{c_{ij}}, \frac{b_j^-}{b_{ij}}, \frac{c_j^-}{a_{ij}}\right); i = 1,2,\dots,m, j \in C \end{cases} \quad (10)$$

$$c_j = MaxC_{ij}, j \in B$$

$$a_j^- = Mina_{ij}, j \in C$$

Table 10: Standard Data Matrix $\left(\frac{a_{ij}}{c_j}, \frac{b_{ij}}{b_j}, \frac{c_{ij}}{a_j}\right)$

Index	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20
s1	(.3,.6,1)	(.1,.1,.4)	(.8,1,1.3)	.1,.1,.4)	(.3,.7,1.4)	(.6,1,1.8)	(.3,.7,1.4)	(.4,1,2.3)	(.8,1,1.3)	(.3,.7,1.4)	(.8,1,1.3)	(.6,1,1.8)	(.8,1,1.3)	(.6,.8,1.3)	(.3,.7,1.4)	(.3,.7,.7)	(.1,.3,1.4)	(.6,1,1.8)	(.1,.4,1)	(.4,1,2.3)
S2	(.1,.3,.7)	(.1,.3,.7)	(.8,1,1.3)	(.3,.6,1)	(.6,1,1.8)	(.3,.7,1.4)	(.6,1,1.8)	(.1,.6,1.7	(.8,1,1.3)	(.1,.4,1)	.6,.8,1.3)	(.3,.7,1.4)	(.3,.6,1)	(.1,.4,1)	(.4,1,2.3)	(.6,.8,1.3)	(.6,1,1.8)	(.1,.4,1)	(.6,1,1.8)	(.1,.6,1.7)
S3	(.8,1,1.3)	(.3,.6,1)	(.3,.6,1)	(.3,.7,.7)	(.1,.3,1.4)	(.6,1,1.8)	(.1,.4,1)	(.4,1,2.3)	(.6,.8,1.3)	(.3,.7,1.4)	(.3,.6,1)	(.6,1,1.8)	(.1,.4,1)	(.4,1,2.3)	(.3,.6,1)	(.3,.7,.7)	(.1,.3,1.4)	(.6,1,1.8)	(.1,.4,1)	(.4,1,2.3)
S4	(.6,.8,1.3)	(.8,1,1.3)	(.8,1,1.3)	(.6,.8,1.3)	(.6,1,1.8)	(.1,.4,1)	(.6,1,1.8)	(.1,.6,1.7)	(.8,1,1.3)	(.1,.4,1)	(.6,.8,1.3	(.1,.4,1)	(.6,1,1.8)	(.1,.6,1.7)	(.8,1,1.3)	(.6,.8,1.3)	(.6,1,1.8)	(.1,.4,1)	(.6,1,1.8)	(.1,.6,1.7)

S5	S6	S7
(.3,.6,1)	(.1,.3,.7)	(.1,.1,.4)
(.6,.8,1.3)	(.3,.6,1)	(.8,1,1.3)
(.1,.3,.7)	(.1,.3,.7)	(.6,.8,1.3)
(.3,.6,1)	(.8,1,1.3)	(.1,.3,.7)
(.3,.7,1.4)	(.3,.7,1.4)	(.3,.7,1.4)
(.6,1,1.8)	(.3,.7,1.4)	(.6,1,1.8)
(.3,.7,1.4)	(.1,.4,1)	(.1,.1,.6)
(.1,.2,1)	(.1,.6,1.7)	(.4,1,2.3)
(.6,.8,1.3)	(.8,1,1.3)	(.3,.6,1)
(.3,.7,1.4)	(.3,.7,1.4)	(.6,1,1.8)
(.3,.6,1)	(.1,.3,.7)	(.1,.3,.7)
(.6,1,1.8)	(.3,.7,1.4)	(.6,1,1.8)
(.3,.7,1.4)	(.1,.4,1)	(.1,.1,.6)
(.1,.2,1)	(.1,.6,1.7)	(.4,1,2.3)
(.1,.3,.7)	(.1,.3,.7)	(.6,.8,1.3)
(.3,.6,1)	(.8,1,1.3)	(.1,.3,.7)
(.3,.7,1.4)	(.3,.7,1.4)	(.3,.7,1.4)
(.6,1,1.8)	(.3,.7,1.4)	(.6,1,1.8)
(.3,.7,1.4)	(.1,.4,1)	(.1,.1,.6)
(.1,.2,1)	(.1,.6,1.7)	(.4,1,2.3)

Step 3: Computing Weighted Standard Matrix: Since the weighted vector was considered to be equal to 1, the weighted matrix in this study is the same standardized matrix.

$$V_{ij} = w_i \times r_{ij}, \quad j = 1,2,\dots,J;\ i = 1,2,\dots,n$$

Step 4: Computing positive and negative ideals: the positive ideal (A^+) response and the negative ideal (A^-) response for the fuzzy triangular numbers were estimated using the following functions that is obtained as Table 11.

$$A^* = \{ v_1^*,\ v_2^*,\ \dots,\ v_i^* \} = \left\{ \left(\max_j v_{ij} \middle| i \in I' \right), \left(\min_j v_{ij} \middle| i \in I'' \right) \right\},$$

$$A^- = \{ v_1^-,\ v_2^-,\ \dots,\ v_i^- \} = \left\{ \left(\min_j v_{ij} \middle| i \in I' \right), \left(\max_j v_{ij} \middle| j \in I'' \right) \right\}$$

Table 11: Positive and Negative ideal responses

Index	X1	X2	X3	….
A+	(1.4,2.3,3)	(1.4,2.3,3)	(1.4,2.3,3)	(…)
A-	(.1 ,.1,.4)	(.1,.1,.4)	(.1,.3,.7)	(…)

Step 5: Computing the interval of each choice for positive ideal (A^+) and negative ideal (A^-) is as follows:

$$D_j^* = \sqrt{\sum_{i=1}^{n} \left(v_{ij} - v_i^* \right)^2} \quad j = 1,2,\dots,J$$

$$D_j^- = \sqrt{\sum_{i=1}^{n} \left(v_{ij} - v_i^- \right)^2} \quad j = 1,2,\dots,J$$

The distance of each alternative fromD* and D^- are shown in Table 12.

Table 12: The interval of each alternative for ideal

Index	D_I^+	D_I^-
S1	0.128	0.011
S2	0.043	0.096
S3	0.021	0.125

S4	0.092	0.046
S5	0.321	0.234
S6	0.105	0.109
S7	0.123	0.145

Step 6: In this step, the relative proximity of each choice to the ideal can be estimated:

$$CC_j^* = \frac{D_j^-}{D_j^* + D_j^-}, \quad j = 1, 2, \ldots, J$$

Results of Fuzzy TOPSIS analyses are summarized in Table 13.

Table 13: Fuzzy Topsis results for ranking

indices	C_i^+
S1	0.92
S2	0.31
S3	0.14
S4	0.67
S5	0.58
S6	0.49
S7	0.46

S_1 : Bank's strategies
S_4 : Planning and practical plans
S_5: IT Capabilities
S_6 : Stakeholders interactionS_7 : Knowledge management
S_2 : Structures and processes
S_3 : Organizational culture

Comparing the methods
The comparison between presented methods is shown in Table 14.

Discussion and Conclusion:

This study has presented an exploratory case study of Parsian banks and for evaluation ECRM implementation in bank, AHP , Fuzzy AHP and Fuzzy TOPSIS methods has been proposed. Multiple decision-makers are often preferred rather than a single decision-maker to avoid the bias and minimize the partiality in the decision process (Bilsel, Buyukozkan & Ruan, 2006). It should be noted that the criteria in different states and different conditions may be different for organizations.

In methods comparison the index of "organizational culture" has the lowest rank among the effective factors in ECRM, it is recommended that sharing data and accessibility of customer knowledge information should be made possible for the entire staff, a positive view should be created on change of technology, particularly in the area of customer relation, and integrated, collaborative and ECRM-based cultural views should be strengthened.

The index of "structure and processes" is also among the indices identified as the factors with least priority of effect, and in order to strengthen this factor, it is suggested that a suitable, focused organizational structure should be created, bank's organizational plans should be made compatible with the ECRM systems, processes of business, interaction with customers, marketing, sale.

From among the indices studied, banks’strategy is treated as the most effective factor. These factors include: customer-orientation viewpoint and customer-satisfaction-based market-orientation, commitment to change and implementation of CRM plans, organization's top management supporting allocation of time and budget for training staff on how to develop ECRM systems.

Development of the technologies relating to that of the ECRM systems, presence of experts and managers well-versed in IT for managing customer relationship projects, implementing practical plans, and a reduction in the routes of fulfilling customer requests through adjusting suitable software and hardware systems have placed the indices relating to "IT capabilities".

Although these methods were developed and tested for use in this study , it can also be used with slight modifications in other decision-making. Also, mathematical models or genetic algorithm or neural network can be combined with them. This will improve the proposed method and is one of the directions in our future research.

Table 14: Comparing the level of Parsian Banks' readiness for implementing ECRM by different methods

AHP	Fuzzy-AHP	Fuzzy-Topsis
IT Capabilities	IT Capabilities	Bank's strategies
Bank's strategy	Bank's strategy	Planning and practical plans
Planning and practical plans	planning and practical plans	IT Capabilities
Structures and processes	Stakeholders interaction	Stakeholders interaction
Knowledge management	structures and processes	Knowledge management
stakeholders Interaction	knowledge management	Structures and processes
Organizational culture	organizational culture	Organizational culture

REFERENCES

Abo-Sinna, M.A., A.H. Amer, 2005. Extensions of TOPSIS for multi-objective large-scale nonlinear programming problems. Appl Math Comput., 162: 243-256.

Ahmed, T., 2009. "Electronic Customet Relationship Management in Online Banking"; Lulea University of technology, 5(23): 435-448.

Almotair Mohammad, 2008. "CRM Success Factors Taxonomy", European and Mediterranean Conference on Information Systems, pp: 25-26.

Benitez, J.M., J.C. Martin, C. Roman, 2007. Using fuzzy number for measuring quality of service in the Hotel industry. Tour Manage, 28: 544-555.

Bilsel, R.U., G. Büyüközkan, D. Ruan, 2006. "A fuzzy preference-ranking model for a quality evaluation of hospital web sites", International Journal of Intelligent Systems, 21(11): 1181-1197.

Chan, F.T.S., N. Kumar, M.K. Tiwari, H.C.W. Lau, & K.L. Choy, 2007. Global supplier selection: a fuzzy-AHP approach. International Journal of Production Research, doi:10.1080/00207540600787200.

Chang, D.Y., 1996. Applications of the extent analysis method on fuzzy AHP. Eur J Oper Res., 95: 649-655.

Chatterjee, D. and B. Mukherjee, 2010. "Study of Fuzzy-AHP Model to Search the Criterion in the Evaluation of the Best Technical Institutions: A Case Study," *International Journal Engineering Science and Technology*, 2(7): 2499-2510.

Chatterjee, D., S. Chowdhury, B. Mukherjee, 2010, A Study of the Application of Fuzzy Analytical Hierarchical Process (FAHP) in the Ranking of Indian Banks, International Journal of Engineering Science and Technology, 2(7): 2511-2520.

Chen, C.T., 2000. Extensions of the TOPSIS for group decisionmaking under fuzzy environment. Fuzzy Sets Syst., 114: 1-9.

Chen, C.T., C.T. Lin, S.F. Huang, 2006. A fuzzy approach for supplier evaluation and selection in supply chain management. Int J Prod Econ, 102: 289-301.

Chia-Chi Sun, 2010. A performance evaluation model by integrating fuzzy AHP and fuzzy TOPSIS methods, Expert Systems with Applications., 37: 7745-7754.

Chu, T.C., 2002. Selecting plant location via a fuzzy TOPSIS approach. Int J Adv Manuf Technol., 20: 859-864.

Chu, T.C., Y.C. Lin, 2003. A fuzzy TOPSIS method for robot selection. Int J Adv Manuf Technol., 21: 284-290.

Dagˇdeviren, M., & I. Yuksel, 2008. Developing a fuzzy analytic hierarchy process (AHP) model for behavior-based safety management. Information Science, 178: 1717-1733.

Erensal, Y.C., T. Öncan and M.L. Dernircan, 2006. Determining Key Capabilities in Technology Management using Fuzzy Analytic Hierarchy Process: A Case Study of Turkey," *Information Science*, 176(18): 2755-2770.

Harrigan Paul, Schroeder Andreas, 2010. Israr Qureshi, Yulin Fang, Elaine Ramsey, Patrick Ibbotson, and Darren Meister. "Internet Technologies, eCRM Capabilities and Performance Benefits of SMEs – An Exploratory Study" International Journal of Electronic Commerce.

Hwang, C.L., K. Yoon, 1981. Multiple attributes decision making methods and applications. Springer, Berlin.

Iranmanesh, H., S. Nazari Shirkouhi and M.R. Skandari, 2008. Risk Evaluation of Information Technology Projects Based on Fuzzy Analytic Hierarchal Process, International Journal of Computer and Information Science and Engineering, 2: 38-44.

Jahanshahloo, G.R., L.F. Hosseinzadeh, M. Izadikhah, 2006. Extension of the TOPSIS method for decision-making problems with fuzzy data. Appl Math Comput., 181: 1544-1551.

kennedy, A., 2006. Electronic Customer Relationship Management (eCRM): Opportunities and Challenges in a Digital World, Irish Marketing Review ,Special Issue, 18(1): 58-69.

Kımılog, H. and H. Zaralı, 2009. What signifies success in e-CRM? Marketing Intelligence & Planning., 27 (2): 246-267. Emerald Group Publishing Limited .0263-4503 DOI 10.1108/02634500910945011.

Mendoza, E., Marius Luis, 2007. Alejandre, Perea, Maria, Griman, Anna," Factors for Guaranteeing the CRM strategy Implementation", information and software technology, 49: 913-945.

Ocker, R.J., S. Mudambi, Assessing the Readiness of Firms for CRM: A Literature Review and Research Model, Proceedings of the 36th Hawaii International Conference on System Sciences, 2002 IEEE.

Saaty, T.L., 1980. *the Analytic Hierarchy Process, Planning, Priority Setting, Resource Allocation*, New York: McGraw-Hill.

Sadi-Nezhad, S., & K. Khalili Damghani, 2009. Application of A fuzzy TOPSIS Method Base on Modified Preference Ratio and Fuzzy Distance Measurement in Assessment of Traffic Police Centers Performance, *Applied Soft Computing*, 10(4): 1028-1039 doi:10.1016/j.asoc.2009.08.036.

Shih, H.S., H.J. Shyur, & E.S. Lee, 2007. An extension of TOPSIS for group decision making. Mathematical and Computer Modelling, 45(7/8): 801-813.

Srichetta Phanarut and Thurachon Wannasiri, 2012, Applying Fuzzy Analytic Hierarchy Process to Evaluate and Select Product of Notebook Computers, *International Journal of Modeling and Optimization*, 2(2): 168-173.

Srichetta, P. and W. Thurachon, 2011. “Group Decision Analysis for the Product Selection Problem of Notebook Computers using Fuzzy AHP,” in *Proc. Int. Conf. Computer and Computational Intelligence*, Bangkok, pp: 185-190.

Torlak Gokhan, Sevkli Mehmet, Sanal Mehmet, Selim Zaim ,Analyzing business competition by using fuzzy TOPSIS method: An example of Turkish domestic airline industry, aExpert Systems with Applications., 38(2011): 3396-3406.

Tsaur, S.H., T.Y. Chang, C.H. Yen, 2002. The evaluation of airline service quality by fuzzy MCDM. Tour Manage., 23: 107-115.

Wang, T.C., T.H. Chang, 2007. Application of TOPSIS in evaluating initial training aircraft under fuzzy environment. Expert Syst Appl., 33(4): 870-880.

Wang, Y.J., H.S. Lee, 2007. Generalizing TOPSIS for fuzzy multicriteria group decision making. Comput Math Appl., 53: 1762-1772.

Wu, l., Hung, ch, 2009. A strategy-based process for effectively determining system requirements in eCRM development, information and software technology, 51(9): 1308-1318.

Yalcın Secme, Nes_e, Bayrakdarog̃lu Ali, 2009 . Cengiz Kahraman, Fuzzy performance evaluation in Turkish Banking Sector using Analytic Hierarchy Process and TOPSIS, Expert Systems with Applications., 36: 11699-11709.