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Improving the Effective Factors on E-banking System by using Fuzzy TOPSIS in Parsian Bank

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Abstract: Purpose of this study was an investigation and explanation of effective factors on improving e-banking by using Fuzzy TOPSIS in Parsian bank. Based on, it reviewed literature of e-banking in special. Instruments of collecting data were documents and interviews, to explain effective factors on improving the e-banking by emphasize on fuzzy TOPSIS. This method is presenting aiming at solving MCDM problems in which the weights of criteria are unequal. The results are showed in the entire factors; operational, technical and strategic have the most effect on Improving of e-banking. With other words, this bank for endurance in the competitive situation needs to promote e-channel specific marketing, rapid delivery of services, responsive customer service, 24 h availability of services, systems and channels integration, security, having multiple channels, mixed strategy selection of vendors and systematic change management.

Key words: Operational, technical, strategic, e-banking, fuzzy TOPSIS

INTRODUCTION

The area of e-banking has appeared in IS literature since the mid-1990s (Buhl and Will, 1998; Devlin, 1995; King and Liou, 2004; Liao and Cheung, 2002; Scruggs and Nam, 2002; Yan and Paradi, 1998; Yousafzai *et al*., 2003, 2005). There is a lack of case studies reporting the actual experience of organizations in implementing e-banking. This gap in the research poses problems for banks, because the limitations in relation to this area usually mean difficulties for them in planning and implementing e-banking (Daniel, 1999; Southard and Siau, 2004). The importance of e-banking as a financial services delivery channel is growing because of its wider reach and low cost per transaction. The Internet as a channel for services delivery is fundamentally different from other channels, such as branch networks or telephone banking, because of its interactive nature. Therefore, it brings up unique types of challenges and requires novel solutions (King and Liou, 2004; Southard and Siau, 2004; Yan and Paradi, 1998). Liao and Cheung (2002), Sathye (1999) and Yan and Paradi (1998) have explored the perception of customers about e-banking. King and Liou (2004) and Harden (2002) compared the e-channel with other channels. Some strategic issues such as outsourcing of e-banking initiatives have been discussed by Cantoni and Rossignoli (2000) or competitive advantage of e-banking by Griffiths and Finlay (2004). To succeed in the e-banking arena, companies need to transform their internal foundations to be effective (Franco and Klein, 1999) with strategic factors. The new type of business would consist of finely tuned integration of business, technology and processes (El Sawy *et al*., 1999; Enos, 2001). Web based services have to be more convenient, easier to use and less expensive than the alternative, to win the loyalty of consumers (Cronin, 1998). Mols (1998) suggested that banks should use the Internet as an additional channel of distribution and must keep their traditional channels such as branches and phone banking, intact. This gives the banks the opportunity for a gentle transition from a branch banking strategy to e-banking strategy and it provides good market coverage. Cronin (1998) proposed branding as a transferable resource across physical and social barriers to entry for customers in a new and perceptibly daunting environment. This point was also stressed by Yousafzai *et al*. (2005).

Security, which may include protection of consumers personal data and safe transactions to

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prevent misuse, is paramount for the growth of any sort of online trade, including e-banking. Security in this context includes secure transactions as well as secure front end and back up systems. Franco and Klein (1999) stressed the importance of upgrading existing technological infrastructure to bring it up to the speed with the Internet trade. Storey *et al*. (2000) state that technology failures lead to loss of custom, often forever. Shortcomings in technological infrastructure are often the biggest hurdle in adoption of the e-banking channel and its integration with other channels (Shah *et al*., 2003). Security is mentioned as a very critical factor by Enos (2001), Turban *et al*. (2000) and Regan and Macaluso (2000). Lack of it, or consumers' fears about it, is one of the biggest obstacles in the growth of e-commerce. The most common factor cited by many in literature, is good customer service (Liao and Cheung, 2002; Orr, 2004). Legislation has increased customers' rights while technology and competition have increased their choice of products and providers. The Internet and changes in social behaviors will result in the growth of users with sophisticated needs and new channels are required to serve most of these needs (Jayawardhena and Foley, 2000). Harden (2002) argueds that e-channels erode a direct relationship with customers and stresses the need for personalization in customer communication. Stamoulis (2000) saw re-drawing the Internet market map as a vital prerequisite for e-banking strategy, because the Internet requires different marketing methods than other service distribution channels. A similar point has been made by Fruhling and Digman (2000) when they wrote that the Internet is having significant effects on market development strategies. According to Jayawardhena and Foley (2000), banks must continually invent new products and services in light of changes brought by the Internet and also make existing products more suitable for online delivery. Similarly, Riggins (1999) identified a number of critical success factors of Internet banking in the context of the Australian banking industry.

Therefore, to the mentioned subjects describe the importance and role of the e-banking to improve in competitive conditions. In this research, effective factors on improving of e-banking would be study. In the other words, this study focus on improving of e-banking by using Fuzzy TOPSIS in Parsian bank, so it would be try to answer this questions, which factors are most important on improving of e-banking in Parsian bank by Fuzzy TOPSIS approach.

MATERIALS AND METHODS

The principal result of any classification process is the interpretation that can improve problem-solving performance in the domain of interest (Ciarapica and Giacchetta, 2008). Therefore, classifying among a set of variables is a complex and common problem even in occupational safety. In this study e-banking refers to e-business factors by using fuzzy TOPSIS approach. The fuzzy TOPSIS is the fuzzy extension of TOPSIS to efficiently handle the fuzziness of the data involved in the decision making (Salehi and Tavakkoli-Moghaddam, 2008; Bellman and Zadeh, 1970). It is easy to understand and it can effectively handle both qualitative and quantitative data in the Multi-Attribute Decision Making (MADM) problems (Abo-Sinna and Amer, 2005; Hwang and Yoon, 1981; Yoon, 1980; Chen, 2000).

Its area is about banking, especially e-banking. This study was conducted in 2009 and its local domain was Parsian bank (this bank have 200 branches in Iran).

There are three alternatives according to their influence on e-banking includes; strategic, technical and operational that all of them are related to nine criteria encompass; multiple channels, mixed strategy selection of vendors, systematic change management, systems and channels integration, Security, e-channel specific marketing, rapid delivery of services, fast responsive customer service and 24 h availability of services.

In order to critically evaluating and validity the used factors (Hult and Ferrell, 1997) in questionnaire, there is some study and testes on factors by the experts, after final modified questionnaire would be used.

RESULTS

Definitions: Here, some basic important definitions of fuzzy sets are given:

Fuzzy: Most of the time gathered information for some reason isn't very exactly (crisp) and is along with lack of certainty, that can be modeling as Fuzzy model.

- **Membership dependency:** Is a dependency which describe X variable at [0,1]:

$$\mu(x):\rightarrow[0,1]$$

- **Normal fuzzy No.:** ã is told as normal Fuzzy No. which its membership dependency is equally to one in accordance to some points (Amiri, 2008).
- **Fuzzy No.:** A fuzzy No. ã is a fuzzy convex subset of the real line satisfying the following conditions:
  - $\mu_{\tilde{A}}(x)$ is piecewise continuous.
  - $\mu_{\tilde{A}}(x)$ is normalized, that is, there exists $m\in\Re$ with $\mu_{\tilde{A}}(m)=1$, where m is called the mean value of ã (Amiri *et al*., 2009a, b).

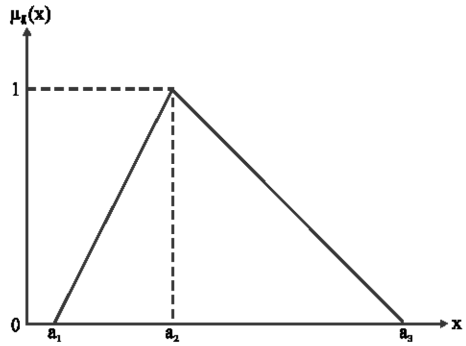

Fig. 1: A triangular fuzzy number ã

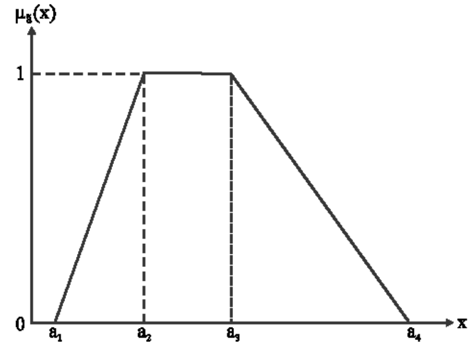

Fig. 2: A trapezoidal fuzzy number ã

- **Triangular fuzzy No. ã:** A triangular fuzzy No. ã can be defined by a triplet (a_1, a_2, a_3). Its conceptual schema and mathematical form are shown by equation below:

$$\mu_{\tilde{a}}(x) = \begin{cases} 0, & x < a_1 \\ \dfrac{x - a_1}{a_2 - a_1}, & a_1 < x \le a_2 \\ \dfrac{a_3 - x}{a_3 - a_2}, & a_2 < x \le a_3 \\ 0, & a_3 < x \end{cases}$$

A triangular fuzzy number ã in the universe of discourse X that conforms to this definition has been shown in Fig. 1.

- **Trapezoidal fuzzy No. ã:** A trapezoidal fuzzy number ã can be defined by quadruplet (a_1, a_2, a_3, a_4) (Amiri *et al.*, 2009a, b). Its conceptual schema and mathematical form are shown by equation below:

$$\mu_{\tilde{a}}(x) = \begin{cases} 0, & x \le a_1 \\ \dfrac{x - a_1}{a_2 - a_1}, & a_1 < x \le a_2 \\ 1, & a_2 < x < a_3 \\ \dfrac{a_3 - x}{a_3 - a_2}, & a_3 < x \le a_4 \\ 0, & a_4 > x \end{cases}$$

A trapezoidal fuzzy No. ã in the universe of discourse X that conforms to this definition has been shown in Fig. 2.

Fuzzy TOPSIS: The TOPSIS is widely used for tackling ranking problems in real situations. This method is often criticized for its inability to adequately handle the inherent uncertainty and imprecision associated with the mapping of the decision-maker's perception to crisp values. In the traditional formulation of the TOPSIS, personal judgments are represented with crisp values. However, in many practical cases the human preference model is uncertain and decision-makers might be reluctant or unable to assign crisp values to the comparison judgments (Chan and Kumar, 2007). Having to use crisp values is one of the problematic points in the crisp evaluation process. One reason is that decision-makers usually feel more confident to give interval judgments rather than expressing their judgments in the form of single numeric values. As some criteria are difficult to measure by crisp values, they are usually neglected during the evaluation. Another reason is mathematical models that are based on crisp value. These methods cannot deal with decision-makers' ambiguities, uncertainties and vagueness which cannot be handled by crisp values. The use of fuzzy set theory (Zadeh, 1975) allows the decision-makers to incorporate unquantifiable information, incomplete information; non-obtainable information and partially ignorant facts into decision model (Kulak and Kahraman, 2005). As a result, fuzzy TOPSIS and its extensions are developed to solve ranking and justification problems (Büyük-zkan *et al.*, 2008; Chen and Tsao, 2007; Kahraman *et al.*, 2007; Onüt and Soner, 2007; Wang and Elhag, 2006; Yong, 2006). This study uses triangular fuzzy number for fuzzy TOPSIS. The reason for using a triangular fuzzy number is that it is intuitively easy for the decision-makers to use and calculate. In addition, modeling using triangular fuzzy numbers has proven to be an effective way for formulating decision problems where the information available is subjective and imprecise (Chang and Yeh, 2002; Chang *et al.*, 2007; Kahraman *et al.*, 2004; Zimmerman, 1996). In practical applications, the triangular form of the membership function is used most often for representing fuzzy numbers (Xu and Chen, 2007).

Table 1: Decision matrix and weighting vector

Factors	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
A_1	[7,9,10]	[5,7,9]	[9,10,10]	[0,1,3]	[3,5,7]	[1,3,5]	[0,1,3]	[1,3,5]	[1,3,5]
A_2	[1,3,5]	[3,5,7]	[3,5,7]	[9,10,10]	[,0,0]	[5,7,9]	[3,5,7]	[1,3,5]	[1,3,5]
A_3	[3,5,7]	[1,3,5]	]5,7,9]	[3,5,7]	[1,3,5]	[7,9,10]	[7,9,10]	[3,5,7]	[7,9,10]
W	[0.3,0.5,0.7]	[0.3,0.5,0.7]	[0.5,0.7,0.9]	[0.1,0.3,0.5]	[0.7,0.9,1]	[0.3,0.5,0.7]	[0.5,0.7,0.9]	[0.9,1,1]	[0.7,0.9,1]

According to briefly summarized fuzzy theory above, fuzzy TOPSIS steps can be outlined as follows:

Step 1: Construct a decision matrix, assume there m alternatives A_i(I = 1,2. . . , m) to be evaluated against n selection criteria X_j (j = 1, 2, . . . , n). The weighting vector W = (w_1, w_2, . . . , w_j, . . . , w_n) and the decision matrix X = {x_{ij}, I = 1,2, ..., m; j = 1, 2, ..., n}, using the linguistic terms. The weighting vector W represents the relative importance of n selection criteria X_j (j = 1, 2, ..., n) for the problem. The decision matrix X = {x_{ij}, I = 1, 2, ..., m; j = 1, 2, ..., n} represents the utility ratings of alternative A_i with respect to selection criteria X_j. Given the weighting vector W and decision matrix X, the objective of the problem is to rank all the alternatives by giving each of them an overall utility with respect to all selection criteria (Table 1). The decision matrix and weighting vector can be expressed as follows:

$$D = \begin{matrix} & \begin{matrix} X_1 & \cdots & X_j & \cdots & X_n \end{matrix} \\ \begin{matrix} A_1 \\ \vdots \\ A_i \\ \vdots \\ A_m \end{matrix} & \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & & \vdots & & \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & & \vdots & & \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix} \end{matrix}$$

$$W = \left[w_1, \ldots, w_j, \ldots, w_n\right]$$

There are nine criteria, which their notations are below:

- X_1 : Having multiple channels
- X_2 : Mixed strategy selection of vendors
- X_3 : Systematic change management
- X_4 : Systems and channels integration
- X_5 : Security
- X_6 : e-channel specific marketing
- X_7 : Rapid delivery of services
- X_8 : Fast responsive customer service
- X_9 : Twenty four hour availability of services

And three alternatives need to be considered:

- A_1 : Strategic factors
- A_2 : Technical factors
- A_3 : Operational factors

Step 2: The decision matrix needs to be normalized for each criterion X_j (j = 1, 2 . . . n) to obtain the projection value of each criterion.

In triangular fuzzy number (this research used triangular fuzzy number Table 2):

$$\tilde{r}_{ij} = \begin{cases} \text{If } x_{ij} \text{ is positive} & \tilde{x}_{ij}(/)\tilde{x}_j^{+} = \left(\dfrac{a_{ij}}{c_j^{+}}, \dfrac{b_{ij}}{b_j^{+}}, \dfrac{c_{ij}}{a_j^{+}}\right) \\ \text{If } x_{ij} \text{ is negative} & \tilde{x}_{ij}^{-}(/)\tilde{x}_j = \left(\dfrac{a^{-}_j}{c_{ij}}, \dfrac{b^{-}_j}{b_{ij}}, \dfrac{c^{-}_j}{a_{ij}}\right) \end{cases}$$

In trapezoid fuzzy number:

$$\tilde{r}_{ij} = \begin{cases} \text{If } x_{ij} \text{ is positive} & \tilde{x}_{ij}(/)\tilde{x}_j^{+} = \left(\dfrac{a_{ij}}{d_j^{+}}, \dfrac{b_{ij}}{c_j^{+}}, \dfrac{c_{ij}}{b_j^{+}}, \dfrac{d_{ij}}{a_j^{+}}\right) \\ \text{If } x_{ij} \text{ is negative} & \tilde{x}_{ij}^{-}(/)\tilde{x}_j = \left(\dfrac{a^{-}_j}{d_{ij}}, \dfrac{b^{-}_j}{c_{ij}}, \dfrac{c^{-}_j}{b_{ij}}, \dfrac{d^{-}_j}{a_{ij}}\right) \end{cases}$$

After normalized the decision matrix, D convert to D' (Table 3):

$$D' = \begin{matrix} & \begin{matrix} X_1 & \cdots & X_j & \cdots & X_n \end{matrix} \\ \begin{matrix} A_1 \\ \vdots \\ A_i \\ \vdots \\ A_m \end{matrix} & \begin{bmatrix} r_{11} & \cdots & r_{1j} & \cdots & r_{1n} \\ \vdots & & \vdots & & \\ r_{i1} & \cdots & r_{ij} & \cdots & r_{in} \\ \vdots & & \vdots & & \\ r_{m1} & \cdots & r_{mj} & \cdots & r_{mn} \end{bmatrix} \end{matrix}$$

Step 3: The fuzzy weighted decision matrix; The $\tilde{v}_{ij}$ for fuzzy weighted decision matrix can be obtained.

In triangular fuzzy No. (Table 4):

$$\begin{cases} \tilde{v}_{ij} = \tilde{r}_{ij}(.)\tilde{w}_j = \left(\dfrac{a_{ij}}{c_j^{+}}, \dfrac{b_{ij}}{b_j^{+}}, \dfrac{c_{ij}}{a_j^{+}}\right) \times (\alpha_j, \beta_j, \chi_j) \\ = \left(\dfrac{a_{ij}}{c_j^{+}}.\alpha_j, \dfrac{b_{ij}}{b_j^{+}}\beta_j, \dfrac{c_{ij}}{a_j^{+}}\chi_j\right) \\ \tilde{v}_{ij} = \tilde{r}_{ij}(.)\tilde{w}_j = \left(\dfrac{a^{-}_j}{c_{ij}}, \dfrac{b^{-}_j}{b_{ij}}, \dfrac{c^{-}_j}{a_{ij}}\right) \times (\alpha_j, \beta_j, \chi_j) \\ = \left(\dfrac{a^{-}_j}{c_{ij}}.\alpha_j, \dfrac{b^{-}_j}{b_{ij}}\beta_j, \dfrac{c^{-}_j}{a_{ij}}\chi_j\right) \end{cases}$$

In trapezoid fuzzy No.:

Table 2: Normalization decision matrix process

Factors	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
r_{ij}	[0.636, 0.529, 0.454]	[0.556, 0.467, 0.429]	[0.529, 0.455, 0.385]	[0, 0.063, 0.15]	[0.231, 0.278, 0.318]	[0.077, 0.158, 0.208]	[0, 0.067, 0.15]	[0.2, 0.273, 0.294]	[0.1113, 02, 0.25]
$\tilde{x}^+$	[7, 9, 10]	[5, 7, 9]	[9, 10, 10]	[9, 10, 10]	[9, 10, 10]	[7,9,10]	[7, 9, 10]	[7, 9, 10]	[7, 9, 10]
$\tilde{x}^-$	[1, 3, 5]	[1, 3, 5]	[3, 5, 7]	[0, 1, 3]	[0, 0,1]	[1,3,5]	[0, 1, 3]	[1, 3, 5]	[1, 3, 5]

Table 3: Normalized decision matrix

Factors	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
A_1	[1,1,1]	[1,1,1]	[1,1,1]	[0,0.1,0.3]	[0.33, 0.5, 0.7]	[0.14,0.33, 0.5]	[0,0.111,0.3]	[0.143,0.33, 0.5]	[0.14, 0.3, 0.5]
A_2	[0.14, 0.3, 0.5]	[0.6,0.71, 0.7]	[0.333, 0.5,0.7]	[1,1,1]	[1,1,1]	[0.71, 0.77,0.9]	[0.429, 0.556, 0.7]	[0.14,0.33, 0.5]	[0.14, 0.3, 0.5]
A_3	[0.42, 0.55, 0.7]	[0.2, 0.42, 0.556]	[0.556, 0.7,0.9]	[0.33,0.5, 0.7]	[0.111,0.3,0.5]	[1,1,1]	[1,1,1]	[0.42, 0.55,0.7]	[1,1,1]

Table 4: The fuzzy weighted decision matrix

Factors	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
A_1	[0.3, 0.5, 0.7]	[0.3,0.5,0.7	[0.5, 0.7, 0.9]	[0,0.03,0.15]	[0.23, 0.4,0.7]	[0.04, 0.1, 0.35]	[0, 0.07,0.27]	[0.12, 0.33,0.5	[0.1,0.3,0.5]
A_2	[0.04, 0.16, 0.35]	[0.18,0.35,0.54]	[0.16,0.35,0.63]	[1,0.3,0.5]	[0.7, 0.9,1]	[0.21, 0.3, 0.63]	[0.21, 0.3,0.63]	[0.12,0.33,0.5	[0.1,0.3,0.5
A_3	[0.12,0.27, 0.49]	[0.06, 0.21, 0.38]	[0.27,0.49,0.81]	[0.03,0.15,0.35]	[0.07, 0.2,0.5]	[0.3, 0.5, 0.7]	[0.5, 0.7,0.9]	[0.38,0.56,0.7	[0.7,0.9,1]

Table 5: PIS A^+ and NIS A^-

Factors	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
A_1	0.500	0.500	0.700	0.060	0.461	0.187	0.116	0.321	0.300
A_2	0.187	0.361	0.382	0.300	0.867	0.411	0.411	0.321	0.300
A_3	0.299	0.221	0.526	0.178	0.283	0.500	0.700	0.547	0.867

$$
\begin{cases}
\tilde{v}_{ij} = \tilde{r}_{ij} \times \tilde{w}_j = \left(\dfrac{a_{ij}}{d_j^+}, \dfrac{b_{ij}}{c_j^+}, \dfrac{c_{ij}}{b_j^+}, \dfrac{d_{ij}}{a_j^+}\right) \times \begin{pmatrix} \alpha_j, \beta_j, \\ \chi_j, \delta_j \end{pmatrix} \\
= \left(\dfrac{a_{ij}}{c_j^+}.\alpha_j, \dfrac{b_{ij}}{b_j^+}\beta_j, \dfrac{c_{ij}}{a_j^+}\chi_j, \dfrac{d_{ij}}{a_j^+}.\delta_j\right) \\
\tilde{v}_{ij} = \tilde{r}_{ij} \times \tilde{w}_j = \left(\dfrac{a^-{}_j}{d_{ij}}, \dfrac{b^-{}_j}{c_{ij}}, \dfrac{c^-{}_j}{b_{ij}}, \dfrac{d^-{}_j}{a_{ij}}\right) \times \begin{pmatrix} \alpha_j, \beta_j, \\ \chi_j, \delta_j \end{pmatrix} \\
= \left(\dfrac{a^-{}_j}{c_{ij}}.\alpha_j, \dfrac{b^-{}_j}{b_{ij}}\beta_j, \dfrac{c^-{}_j}{a_{ij}}\chi_j, \dfrac{d^-{}_j}{a_{ij}}.\delta_j\right)
\end{cases}
$$

The first and second formulas were for positive and negative criterion. All computed relevant to v matrix in below:

$$
V = \begin{matrix} \\ A_1 \\ \vdots \\ A_i \\ \vdots \\ A_m \end{matrix}
\begin{matrix} x_1 \;\cdots\; x_j \;\cdots\; x_n \\
\begin{bmatrix}
\tilde{v}_{11} & \cdots & \tilde{v}_{1j} & \cdots & \tilde{v}_{1n} \\
\vdots & & \vdots & & \\
\tilde{v}_{i1} & \cdots & \tilde{v}_{ij} & \cdots & \tilde{v}_{in} \\
\vdots & & \vdots & & \\
\tilde{v}_{m1} & \cdots & \tilde{v}_{mj} & \cdots & \tilde{v}_{mn}
\end{bmatrix}
\end{matrix}
$$

Step 4: Determine the positive ideal solution (PIS) A^+ and the negative ideal solution (NIS) A^-. Sort the weighted normalized values for each criterion adapted to Leeandli.

In triangular fuzzy No. (Table 5):

$$
M(v_{ij}) = \frac{-a_{ij}^2 + c_{ij}^2 - a_{ij}b_{ij} + c_{ij}b_{ij}}{3(a_{ij} + c_{ij})}
$$

In trapezoid fuzzy No.:

$$
M(v_{ij}) = \frac{-a_{ij}^2 - b_{ij}^2 + c_{ij}^2 + d_{ij}^2 - a_{ij}b_{ij} + c_{ij}d_{ij}}{3(-a_{ij} - b_{ij} - c_{ij} - d_{ij})}
$$

Step 5: Calculate the distance from the positive ideal solution and the negative ideal solution for each alternative.

According to Zadeh definition about distance between two fuzzy numbers is:

$$
D_{ij}^+ = 1 - \sup_x \left\{ \min\left[\alpha_{v_{ij}}(x), \alpha_{v_j^+} \right] \right\}
$$

$$
D_{ij}^- = 1 - \sup_x \left\{ \min\left[\alpha_{v_{ij}}(x), \alpha_{v_j^-} \right] \right\}
$$

Then the distance between two triangular fuzzy numbers $v_j^+ = (a^+, b^+, c^+), v_j^- = (a^-, b^-, c^-)$ is calculated as:

$$
D_{ij}^+ = \begin{cases} 1 - \dfrac{c_{ij} - a^+}{b^+ + c_{ij} - a^+ - b_{ij}}, & \text{for}\left(b_{ij} \prec b^+\right) \\ 1 - \dfrac{c^+ - a_{ij}}{b_{ij} + c^+ - a_{ij} - b^+}, & \text{for}\left(b^+ \prec b_{ij}\right) \end{cases}
$$

$$
D_{ij}^- = \begin{cases} 1 - \dfrac{c_{ij} - a^-}{b^- + c_{ij} - a^- - b_{ij}}, & \text{for}\left(b_{ij} \prec b^-\right) \\ 1 - \dfrac{c^- - a_{ij}}{b_{ij} + c^- - a_{ij} - b^-}, & \text{for}\left(b^- \prec b_{ij}\right) \end{cases}
$$

D_{ij}^+ (Table 6) and D_{ij}^- (Table 7) are defuzzification, then:

$$
\text{If } x_{ij} \text{ is positive} \qquad S_i^+ = \sum_{j=1}^{n} D_{ij}^+
$$

$$
\text{If } x_{ij} \text{ is negative} \qquad S_i^- = \sum_{j=1}^{n} D_{ij}^-
$$

Step 6: Calculate the closeness coefficient. And rank each closeness coefficient of each alternative in descending

Table 6: The distance from the positive ideal solution

Factors	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	Total
A_1	2.5	2.5	1.5	8.0833	2.2	4.545454	4.79769	4.00	3.5	33.62648
A_2	4.54545	3.43220	2.32143	3.5	1.0	2.5346	2.53456	4.00	3.5	27.36821
A_3	3.40314	4.5	1.59375	4.25	3.1739	2.5	1.5	3.08	1.0	24.99773

Table 7: The distance from the negative ideal solution

Factors	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	Total
A_1	0.4545	0.21845	0.5	0.31818	0.36	0.44586	0.1099	0.0	0.08537	2.49229
A_2	0.04459	0.171756	0.33582	0.5	1.5	0.1628	0.8517	0.0	0.08537	3.651968
A_3	1.354749	0.5315	2.3089	0.15789	0.14005	0.45454	1.51429	0.66038	1.68852	8.810823

Table 8: Closeness coefficient

Factors	Values	Ranking
A_1	0.0690026	3
A_2	0.1177288	2
A_3	0.2606093	1

Table 9: A comparative taxonomy of critical success factors on e-banking in the Parsian

Factors-in literature	References	Factors in the Parsian
Strategic factors		
Integrating different channels	Franco and Klein (1999), King and Liou (2004)	Having multiple channels
Treating e-commerce as a business project (not just a technological project)	Fruhling and Digman (2000)	Systematic change management
Internally and externally	Turban *et al*. (2000)	Mixed strategy selection of
Operational factors		
Simplifying and integrating basic services	Enos (2001)	Rapid delivery of services 24 h availability of services
Good customer services	Jayawardhena and Foley (2000), Orr (2004)	Fast responsive customer service
Technical factors		
Integration of technology	El Sawy *et al*. (1999)	Systems and channels integration
Systems security	Enos (2001), Turban *et al*. (2000)	Systems security

order. The alternative with the highest closeness coefficient value will be the best choice (Table 8).

$$C_i^+ = \frac{S_i^+}{S_i^+ + S_i^-}$$

Finally, with attention to Table 8, the value of each alternative for final Ranking will be:

$$A_3 > A_2 > A_1$$

DISCUSSION

E-banking in the Parsian is summarized and compared with other found in literature (Table 9). Franco and Klein (1999) and King and Liou (2004) focus to Integrating different channels; Fruhling and Digman (2000) survey on treating e-commerce as a business project (not just a technological project); Turban *et al*. (2000) investigation of electronic commerce on internally and externally condition that their founding were similar to strategy factor.

Jayawardhena and Foley (2000) and Orr (2004) studies of good customer services and Enos (2001) scrutiny on simplifying and integrating basic services in online banking; that their founding were similar to operational factor.

Enos (2001) and Turban *et al*. (2000) focus on systems security in e-commerce and e-banking. So, El Sawy *et al*. (1999) surveys to integrating of technology that their founding were similar to technical factor.

CONCLUSION

This study has presented an exploratory case study of Parsian bank. The Parsian which has been successful in implementing e-banking. This research aimed to explore how this bank went about managing successful adoption of their e-banking channel by emphasize on fuzzy TOPSIS, what were the criteria's to their success and what key lessons came out of their experience. We concluded the banks need to improve operational, technical and strategic factors by sort as keys component of their business strategy, because they would need to implement considerable multiple channels, change management, channels integration, e-channel, rapid delivery of services, fast responsive customer service and etc. in order to web-enable themselves. They also would need to promote e-commerce within the organization, which helps in its acceptance by their staff.

According to this study, these themes are as direction to further research: studying the other criteria's of effect on e-banking by new techniques, priority and identify impediment of e-banking by other methods.

REFERENCES

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

Amiri, A.P., 2008. The investigation and explanation of local model of effective factors on stock price index in Tehran stock exchange with fuzzy approach. M.A. Thesis. Islamic Azad University-Babol Branch.

Amiri, A.P., M.P. Amiri and M.P. Amiri, 2009a. Designing a new model of effective financial factors on TEPIX with structural equation model and fuzzy approach. J. Applied Sci.

Amiri, P., A. Pakdin, A. Morteza and P.A. Mojtaba, 2009b. The investigation and explanation of local model of effective internal factors on stock price index in Tehran stock exchange with fuzzy approach. J. Applied Sci., 9: 258-267.

Bellman, R.E. and L.A. Zadeh, 1970. Decision-making in a fuzzy environment. Manage. Sci., 17: 141-164.

Buhl, H.U. and A. Will, 1998. Economic aspects of electronic commerce in financial services and advantageous steps to extended offers in Internet banking. Proceedings of the 31st Hawaii International Conference, Jan. 6-9, System Sciences, pp: 282-289.

Büyük-zkan, G., O. Feyzioglu and E. Nebol, 2008. Selection of the strategic alliance partner in logistics value chain. Int. J. Prod. Econ., 113: 148-158.

Cantoni, F. and C. Rossignoli, 2000. New distribution models for financial services: The Italian Banks' approach to on-line trading development. J. Elect. Commerce Res., 1: 1-10.

Chan, F.T.S. and N. Kumar, 2007. Global supplier development considering risk factors using fuzzy extended AHP-based approach. Omega, 35: 417-418.

Chang, Y.H. and C.H. Yeh, 2002. A survey analysis of service quality for domestic airlines. Eur. J. Operat. Res., 139: 166-177.

Chang, Y.H., H.Y. Chung and S.Y. Wang, 2007. A survey and optimization-based evaluation of development strategies for the air cargo industry. Int. J. Prod. Econ., 106: 550-562.

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

Chen, T.Y. and C.Y. Tsao, 2007. The interval-valued fuzzy TOPSIS methods and experimental analysis. Fuzzy Sets Syst., 159: 1410-1428.

Ciarapica, F.E. and G. Giacchetta, 2008. Classification and prediction of occupational injury risk using soft computing techniques: An Italian study. Saf. Sci., 47: 36-49.

Cronin, M.J., 1998. Defining Net Impact: The Realignment of Banking and Finance on the Web: Banking and Finance on the Internet. Wiley, New York, USA.

Daniel, E., 1999. Who dares wins? On-line banking services and innovation types. Proceedings of 9th Annual Business Information Technology Conference, Nov. 3-4, Manchester, UK., pp: 1-1.

Devlin, J.F., 1995. Technology and innovation in retail banking distribution. Int. J. Bank Market., 13: 19-25.

El Sawy, O.A., A. Malhotra, S. Gosain and K.M. Young, 1999. IT-intensive value innovation in the electronic economy: Insights from marshall industries. MIS Quart., 23: 305-335.

Enos, L., 2001. Report: Critical errors in online banking. E-Commerce Times. http://www.ecommercetimes.com/story/8867.html.

Franco, S.C. and T. Klein, 1999. Online banking report. Piper Jaffray Equity Research.

Fruhling, A.L. and L.A. Digman, 2000. The impact of electronic commerce on business-level strategies. J. Elect. Commerce Res., 1: 1-1.

Griffiths, G. and P.N. Finlay, 2004. IS-enabled sustainable competitive advantage in financial services, retailing and manufacturing. J. Strategic Inform. Syst., 13: 29-59.

Harden, G., 2002. E-banking comes to town: Exploring how traditional UK high street banks are meeting the challenge of technology and virtual relationships. J. Financial Services Market., 6: 323-332.

Hult, G.M.T. and O.C. Ferrell, 1997. A global learning organization structure and market information processing. J. Business Res., 40: 155-166.

Hwang, C.L. and K. Yoon, 1981. Multiple Attribute Decision Making and Applications. Springer-Verlag, New York.

Jayawardhena, C. and P. Foley, 2000. Changes in the banking sector: The case of internet banking in the UK. Internet Res. Elect. Network. Appl. Policy, 10: 19-30.

Kahraman, C., A. Beskese and D. Ruan, 2004. Measuring flexibility of computer integrated manufacturing systems using fuzzy cash flow analysis. Inform. Sci., 168: 77-94.

Kahraman, C., G. Büyük-zkan and N.Y. Ates, 2007. A two-phase multi-attribute decision making approach for new product introduction. Inform. Sci., 177: 1567-1582.

King, S.F. and J. Liou, 2004. A framework for Internet channel evaluation. J. Inform. Manage., 24: 473-488.

Kulak, O. and C. Kahraman, 2005. Fuzzy multi-attribute selection among transportation companies using axiomatic design and analytic hierarchy process. Inform. Sci., 170: 191-210.

Liao, Z. and T. Cheung, 2002. Internet based e-banking and consumer attitude: An empirical study. J. Inform. Manage., 39: 283-295.

Mols, N.P., 1998. The behavioural consequences of PC banking. Int. J. Bank Market., 16: 195-201.

Onüt, S. and S. Soner, 2007. Transshipment site selection using the AHP and TOPSIS approaches under fuzzy environment. Waste Manage., 28: 1552-1559.

Orr, B., 2004. E-banking job one: Give customers a good ride. ABA Bank. J., 96: 56-57.

Regan, K. and N. Macaluso, 2000. Report: Consumers cool to net banking. E-Commerce Times, https://www.linuxinsider.com/story/4449.html.

Riggins, F.J., 1999. A framework for identifying web-based electronic commerce opportunities. J. Org. Comput. Elect. Commerce, 9: 1-11.

Salehi and R. Tavakkoli-Moghaddam, 2008. Project selection by using a fuzzy TOPSIS technique. Proc. World Acad. Sci. Eng. Technol., 30: 85-90.

Sathye, M., 1999. Adoption of internet banking by australian consumers: An empirical investigation. Int. J. Bank Market., 17: 324-334.

Scruggs, L. and K. Nam, 2002. Internet banking in the US, Japan and Europe. Multinational Bus. Rev., 10: 73-81.

Shah, M.H., R.J. Paul and A.W. Khalfan, 2003. A Survey of Critical Success Factors in E-Financial Services Within UK. Department of Computer Science, University of Hertfordshire, UK.

Southard, P.B. and K. Siau, 2004. A survey of online e-banking retail initiatives. Commun. ACM, 47: 99-102.

Stamoulis, D.S., 2000. How banks fit in an Internet commerce business activities model. J. Internet Bank. Commerce, 5: 1-1.

Storey, A., J.B. Thompson, A. Bokma and J. Bradnum, 2000. An evaluation of UK and USA online banking and web sites. Proceedings of the Americas Conference on Information Systems, Aug. 10-13, Long Beachpp, CA, USA., pp: 723-728.

Turban, E., J. Lee, D. King and H.M. Shung, 2000. Electronic Commerce, a Managerial Perspective. Prentice Hall, London, UK.

Wang, Y.M. and T.M.S. Elhag, 2006. Fuzzy TOPSIS method based on alpha level sets with an application to bridge risk assessment. Exp. Syst. Applied, 31: 309-309.

Xu, Z.S. and J. Chen, 2007. An interactive method for fuzzy multiple attributes group decision-making. Inform. Sci., 177: 248-263.

Yan, G. and J.C. Paradi, 1998. Internet-The future delivery channel for banking services? Proceedings of 31st Annual Hawaii International Conference on System Sciences, Jan. 5-8, Internet and Digital Economy Track, IEEE Computer Society, Hawaii, USA., pp: 1-1.

Yong, D., 2006. Plant location selection based on fuzzy TOPSIS. Int. J. Adv. Manufact. Technol., 28: 839-844.

Yoon, K., 1980. System selection by multiple attribute decision making. Ph.D. Thesis, Kansas State University.

Yousafzai, S.Y., J.G. Pallister and G.R. Foxall, 2003. A proposed model of e-trust for electronic banking. Technovation, 23: 847-860.

Yousafzai, S.Y., J.G. Pallister and G.R. Foxall, 2005. Strategies for building and communicating trust in electronic banking: A field experiment. Psychol. Market., 22: 181-202.

Zadeh, L., 1975. The concept of a linguistic variable and its application to approximate reasoning - I. J. Inform. Sci., 8: 199-249.

Zimmerman, H.J., 1996. Fuzzy Sets Theory and its Applications. Kluwer Academic Publisher, Boston.