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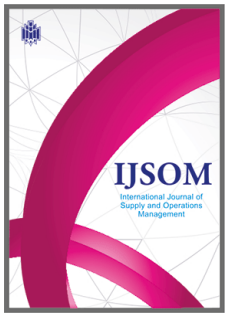

A Fuzzy ANP-SWOT approach for analyzing the IT problems based on capabilities in Iran

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Abstract

Determining strategy, as a very effective tool for policy (and especially science and technology policy), helps governments to be able in the challenges such as globalization and increased competition, and have an appropriate respond in the world today. Although some scattered researches about strategy determining have been conducted in Iran, the purpose of them is to recognize the future of Information Technology (IT) and determine a framework for strategy determining. This paper examines the situation of Iran in IT. First, according to the techniques of the strategy formulation, the most important internal and external factors have been identified, then using matrix strengths, weaknesses, opportunities and threats, the organizational strategies have been developed. Fuzzy ANP Methods were used for quantitative analysis. The results were calculated using the Expert Choice Software. Statistical community of this study will be including the experts in the field collected among 400 experts. According to the results, the best strategy for implementation ST Strategy. Therefore, some strategies should be considered such as: Explicit decisions to expand or change of research program, selecting an independent organization as trustee of futures studies projects, explicit decisions to expand or change of research program, definition and implementation of future studies for appropriate infrastructure.

Keywords: Determining strategy; SWOT analysis; Fuzzy AHP; Fuzzy ANP.

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1. Introduction

Determining strategy is the systematic attempt to look at the long-term future of science, technology, economy, environment and society with the aim of identifying emerging technologies and strengthening the strategic areas of research, which have higher social and economic profitability (Keenan 2003, Santos *et al.* 2004, Safari *et al.* 2014). According to another authoritative definition: Determining strategy is the structured and organized process that integrates people's expectations about technology and develops the strategic visions for the future (Manteghi *et al.* 2011, Gaoa *et al.* 2015). Nowadays, managers' strategic decisions are very important for the organizations to achieve their long-term goals (Kaviani and Abbasi, 2014).

Future study as a tool for determining strategy, first time as the primary instrument of policy in the late '50s and early' 60s in America, especially in the defense sector was used. Then, in 1970, Japan decided to create a national future study of science and technology, with 30-year time horizon. Japan had other goals besides selecting areas of excellence. In other words, Japan intends to provide recommendations for decision makers in both the public and private sectors based on the depth and comprehensive analysis of long-term trends (Nyiri 2003). In Europe, France in the early 80's, then Sweden and Norway conducted its first future study program. In the 90s, governments in many European countries such as Germany, Netherlands and Ireland used this tool. The 90s witnessed a huge explosion of future study activities throughout the world, especially in developed countries (Keenan 2002). According to development of IT and its application in other sciences, the industrialization of developing countries is a necessity. And access to an independent industrial system, need to select an appropriate strategy of futures studies.

Although some scattered researches about future study have been conducted in Iran, the purpose of them is to recognize the future of IT and determine a framework for future study. This paper examined the situation of Iran in IT and selected the best strategy in future study of IT.

Many approaches and techniques are used in the strategic management process (Dincer 2004, Darkow 2014, Granell 2015, Xie 2013). Among these methods, the most common is SWOT analysis. SWOT analysis is an important tool to support decision-making and commonly used as a tool for systematic analysis of the internal and external environments (Rodriguez and Ventura 2003). In this method, the most important internal and external factors as strategic factors influencing the future will be discussed (Kahraman *et al.* 2006). Although the use of appropriate and reasonable SWOT provides a good basis for effective planning strategies, has some weak points. In SWOT analysis, the importance of factors to determine the effect of each factor on the program or strategy is not quantitative and measurable (LengnickHall and LengnickHall 1998). In other words, in this case a useful tool for determining the relative importance of each factor was not present (Kangas *et al.* 2003).

For this reason, the SWOT analysis is not able to evaluate a comprehensive strategic decision-making process. Therefore, this study by combining the SWOT model and Fuzzy ANP are seek to reduce this deficit. Therefore, by combining the SWOT model and Fuzzy ANP, this study seeks to reduce this deficit.

In Iran, IT systems are experiencing early maturity. This course includes a variety of issues and challenges. Some of these challenges involve the country's policies, and others involve software development and special features of these software. Therefore, the answer to this question is very important: "What is the position of Iran in IT based on SWOT Matrix, and which strategies can be used to improve it?" This paper answers these questions based on a Fuzzy ANP-SWOT approach.

According to a study, a multi-criteria decision method and SWOT factors are used to analyze the role of information technology in industry development in Iran (Mahdavi *et al.* 2008). In another study, Rural ICT Development in Iran's Villages with Analyzing Strengths, Weaknesses,

Opportunities, and Threats of Rural ICT were reviewed (Yaghoubi-Farani *et al.* 2011). Also, Saniee (2015) analyzed the role of ICT in sustainable urban development by using Model SWOT. In this paper, Documents and content analysis is a research method and Strategic SWOT descriptive model to evaluate internal and external opportunities and threats of the use of ICT in cities is discussed.
It should be noted that none of these research has been done in a fuzzy approach and this is the distinguish of this study.

2. SWOT-Fuzzy ANP Methods

In this study, to determine the priority of the proposed strategies, SWOT analysis with fuzzy ANP was used. Initially, a group of experts to analyze the internal and external environment of the organization identified the controllable and uncontrollable secondary factors that affect the success of the organization. These secondary factors have a great importance in strategy. SWOT matrix and alternative strategies were formed by using secondary factors of SWOT. In this study, the purpose of using Analytic Network Process is prioritization of proposed strategies and selecting the best strategy in the future study of IT.
To calculate the sample size, the Morgan table is used (Krejcie and Morgan 1970). The data are qualitatively and the number of statistical community is unlimited, therefore according to this table, the sample size obtained 385 cases. To increase accuracy, the data has been distributed and collected among 400 experts.
Final ranking in each of these matrices is the geometric mean of each expert's rankings. The procedure for applying the model is based on a proposal algorithm submitted by Yuksel and Dagdeviren, in 2007.
Based on this algorithm, to compute the final weight of the alternatives in the ANP model usually used the super matrix. Super matrix is a hierarchy of SWOT with four levels that are as follows:

$$W = \begin{matrix} Goal\ (G) \\ Factors\ (F) \\ Subfactors\ (SF) \\ Alternatives\ (A) \end{matrix} \begin{bmatrix} 0 & 0 & 0 & 0 \\ W_{21} & 0 & 0 & 0 \\ 0 & W_{32} & 0 & 0 \\ 0 & 0 & W_{43} & I \end{bmatrix} \quad (1)$$

In this matrix, W_{21} is a vector that shows the effect of goal on factors. W_{32} is a vector that shows the effect of factors on sub factors. W_{43} is a vector that shows the effect of factors on alternatives. Finally, I is the identity matrix. This relationship is shown in Figure 1.

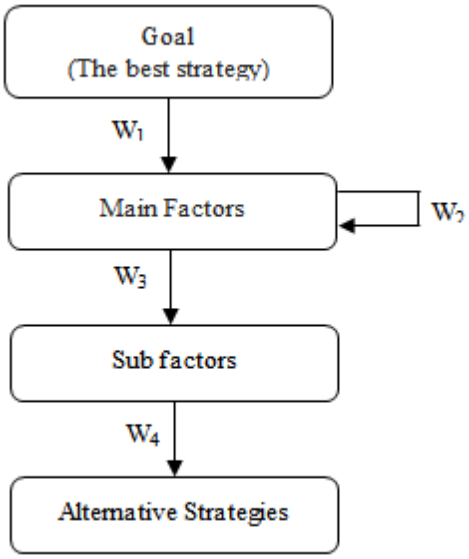

Figure 2. ANP-SWOT

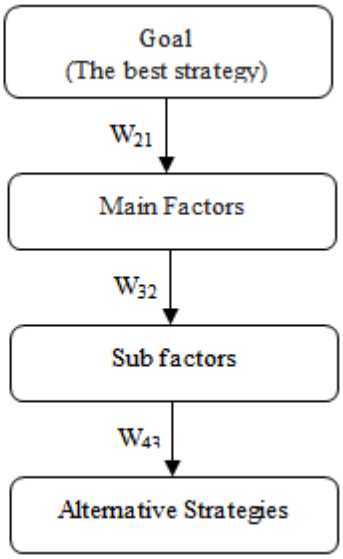

Figure 1. AHP-SWOT

According to Figure 2, there is an internal relationship between the main factors. Therefore, the general case of super matrix in this study is:

$$W = \begin{matrix} Goal\ (G) \\ Factors\ (F) \\ Subfactors\ (SF) \\ Alternatives\ (A) \end{matrix} \begin{bmatrix} 0 & 0 & 0 & 0 \\ W_1 & W_2 & 0 & 0 \\ 0 & W_3 & 0 & 0 \\ 0 & 0 & W_4 & I \end{bmatrix} \quad (2)$$

In this matrix, W_1 is a vector that shows the effect of goal (the best strategy) on factors (Strengths, Weaknesses, Opportunities, Threats). W_2 is a vector that shows the interdependence of factors. W_3 is a vector that show the effect of factors on sub factors (S_1,S_2,.., W_1,W_2,…, O_1,O_2,…,T_1,T_2,..). W_4 is a vector that show the effect of sub factors on alternatives (SO_1,SO_2,.., OW_1,OW_2,…, ST_1,ST_2,…, WT_1,WT_2,..).

3. The fuzzy theory

The method of data analysis in this study is using the fuzzy numbers. This method consists of six steps as follows:

3.1. Determining fuzzy numbers for each of the linguistic variables

In this paper, range sensing for each of the five linguistic factors (*"I agree completely"* to *"I disagree completely"*) were used in the questionnaire which is shown below:
Very Good (VG), Good (G), Middle (M), Weakness (W), Strongly Weakness (SW)

Any of the above factors are defined with triangular membership functions (The triangular fuzzy number A). The reason for this choice is that these numbers are often used in applications of fuzzy logic controllers, management decisions, business and finance, etc. Formula 3 is the triangular fuzzy number A. Also, figure 3 shows the triangular fuzzy number. In applications, point $a_m \in (a_1, a_2)$ is often placed on the middle of triangle. So the following formula is obtained: (Formula 4)

$$\mu_{\tilde{A}}(X) = \begin{cases} 0, & x < a^1 \\ (x - a^1)/(a^m - a^1), & a^1 \le x \le a^m \\ (a^u - x)/(a^u - a^m), & a^1 \le x \le a^m \\ 0, & x > a^u \end{cases} \quad (3)$$

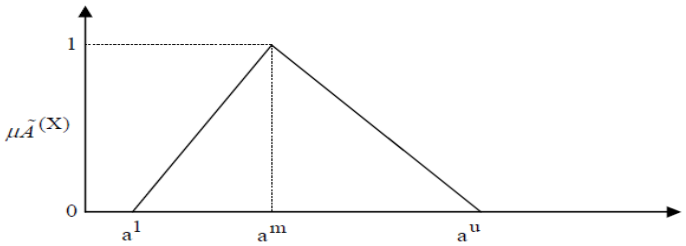

Figure 3. The triangular fuzzy number

$$A\Delta\,\mu_A(x) \begin{cases} \left(2\frac{x-a_1}{a_u-a_1}\right) & a_1 \le x < \frac{a_1+a_u}{2} \\ \left(2\frac{x-a_u}{a_1-a_u}\right) & \frac{a_1+a_u}{2} < x \le a_u \\ 0 & \text{Other Point} \end{cases} \quad (4)$$

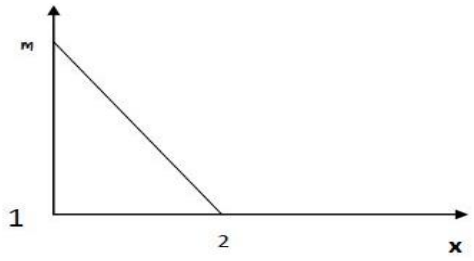

Figure 4. SW fuzzy number

Table 1. Range of linguistic variables using MATLAB

SW	W	M	G	VG
(1,1,2)	(1,2,3)	(2,3,4)	(3,4,5)	(4,5,5)

3.2. Defuzzification

This is the process of producing a quantifiable result in fuzzy logic, given fuzzy sets and corresponding membership degrees. There are various ways to do, but in this paper a fuzzy method is used fuzzy mean for defuzzification.

$$x_{max} = \frac{m_1 + 2m_m + m_u}{4} \quad (5)$$

4. Research process

According to opinions of the experts, SWOT matrix from the perspective of analysis the problems of country and resolve it with capability of future study is as follows:

SWOT		Strengths	Weaknesses
		S_1. There are research groups for future research studies in the country S_2. There is basic knowledge of future study in the country S_3. There are many experts in different fields in the country S_4. There are many experts in fields of ICT S_5. Internet accessibility in public and private organizations S_6. Being young population of country	W_1. Lack of communication between specialists in the country W_2. poor communication between industry, universities and research W_3. There is a tendency to self-interest and lack of active participation in economic and risk appetite W_4. Decentralization and imbalance in future research studies W_5. Unemployment and unequal access to IT services W_6. Low levels of literacy, education and skills in IT
Opportunities	O_1. Creating jobs at home by IT knowledge O_2. officials Support from providing "comprehensive scientific map" O_3. Support and government attention to ICT O_4. The possibility of distance education and learning O_5. Development of software to solve global problems O_6. International Community to eliminate weaknesses in ICT	SO_1. Strategic analysis of future scenarios and creating future paradigm for explaining the socio-economic needs, opportunities and development of future research SO_2. Identifying potential expertise fields for growth and innovation SO_3. Create a shared vision for the future SO_4. providing "comprehensive scientific map in ICT" with a view of future study	OW_1. Create a shared vision for the future OW_2. Prioritization of research and development and technology strategy based on the needs of market and domestic ability OW_3. Coordinating the research and development programs and strategies OW_4. Pay attention to distance education and related laws OW_5. Pay attention to strengthen the communication infrastructure and network of experts and synergies between them with the development of supportive laws
Threats	T_1. Create a deep digital divide If we do not pay attention to IT T_2. The lack of prospective strategy in decision making processes T_3. Low investment in Training T_4. The economy relies on oil revenues rather than knowledge-based economy T_5. Slow proceedings versus the rapid growth of ICT T_6. Lack of adequate infrastructure in ICT	ST_1. Consensus on research priorities and create a shared vision for the future ST_2. Explicit decisions to expand or change of research program ST_3. Design Action Plan ST_4. Definition and implementation of futures studies for appropriate infrastructure. Also the optimal relationship between the network of experts at the country and abroad with an emphasis on new technologies and future technologies ST_5. Selecting an independent organization as trustee of futures studies projects ST_6. Dissemination the information of future, in terms of public education.	WT_1. Restructuring and re-engineering of government, in line with futuristic developments WT_2. Identifying future technologies, Identifying market needs, Identifying potentials of communication WT_3. Gathering of industrialists, academics, decision-makers, futurists, and other stakeholders related to the future of science, technology and innovation to create an intellectual synergy WT_4. Using the application of information technology to improve productivity, quality, efficiency, and reduce costs WT_5. Using the future study experiences of other countries and adapting it to the situation in Iran WT_6. Dissemination the information of future, in terms of public education.

Components of the proposed algorithm are as follow:

Step 1. Initially, the problem organized as an ANP model. This model consists of four levels. The first level is selecting the best strategy. The second level is related to analysis of SWOT factors. Sub factors are located in third level. The fourth level shows the strategy of this study. This model is shown in Figure 5.

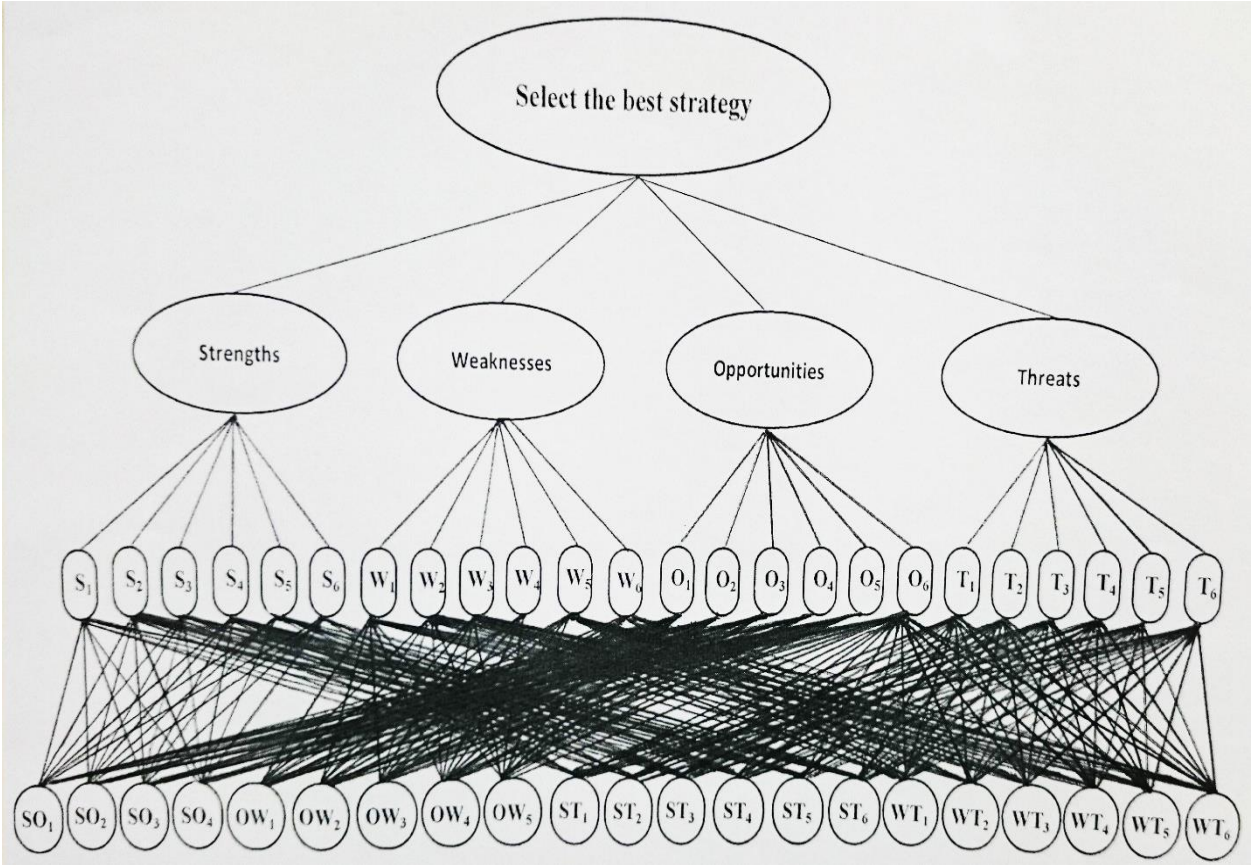

Figure 5. The proposed model for SWOT of Future Study (ANP-SWOT Model)

Step 2. With the assumption that there is mutual dependency among the main factors SWOT, Comparative matrix of the main factors was formed using a scale of one to nine by experts (Likert scale). This matrix is analyzed using the Expert Choice Software and weight vector is obtained. Comparisons have been made with regard to the compatibility matrix.

If $A=[a_{ij}]$ is a m×m matrix, such as this matrix is compatible if $a_{ij} = a_{ik} .a_{kj}$. In all paired comparison matrices, incompatibility of less than 0.1 in comparative matrix is acceptable (Gratton *et al.* 1999).

Step 3. In this step, the interdependencies among the main factors have been determined using paired comparison. Interdependencies among the main factors, are shown in Figure 6. According to the model proposed by Yuksel and Dagdeviren (2007), opportunities will be influenced only by the strength; therefore there is not paired comparison matrix for opportunities.

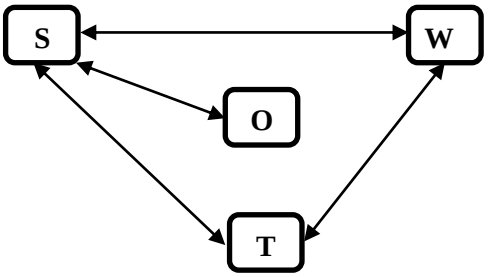

Figure 6. Interdependencies among the main factors (SWOT)

Step 4. In this step, the weight of the interdependence of factors is obtained.
Initially, the multiplication of correlation matrix of the main factors, in relative weights of the main factors is obtained. Therefore, the matrix has been normalized.
Step 5. In this step, the relative weights of the sub factors of SWOT using paired comparisons matrix has been obtained.
Step 6. In sixth step, the overall weight of the sub-factors (W_G) is obtained using the multiplication of weight of main factors (weights obtained in the fourth stage), in relative weights of the sub factors (Tables 2 to 10).

Table 2. Comparing Matrix of the factors and the relative weight of each factor, regardless of the relationship between the criteria with incompatibility rate of 0.845

	S	W	O	T	Weighting of criteria
S	(1,1,1)	(0.6,0.8,0.1)	(0.48,0.72,1)	(0.64,0.82,1)	(0.68,0.83,1)
W	(0.14,0.17,0.23)	(0.14,0.14,0.14)	(0.47,0.62,0.81)	(0.38,0.55,0.73)	(0.28,0.37,0.48)
O	(0.29,0.40,0.60)	(0.05,0.06,0.08)	(0.29,0.29,0.29)	(0.55,0.77,0.97)	(0.29,0.38,0.49)
T	(0.13,0.16,0.20)	(0.02,0.03,0.05)	(0.04,0.05,0.07)	(0.13,0.13,0.13)	(0.08,0.09,0.11)

Table 3. Comparing Matrix of the relative weight of each factor and strengths criteria with incompatibility rate of 0.054

	W	O	T	Mean
W	(0.16,0.16,0.16)	(0.16,0.21,0.33)	(0.38,0.48,0.62)	(0.21,0.28,0.37)
O	(0.48,0.73,1)	(1,1,1)	(0.62,0.81,1)	(0.70,0.85,1)
T	(0.02,0.03,0.05)	(0.11,0.13,0.17)	(0.11,0.11,0.11)	(0.08,0.09,0.11)

Table 4. Comparing Matrix of the relative weight of each factor and weaknesses criteria with incompatibility rate of 0.088

	S	O	T	Mean
S	(0.46, 0.46, 0.46)	(0.22,0.56,1)	(0.47,0.68,0.89)	(0.38,0.57,0.78)
O	(0.22,0.39,1)	(0.47,0.47,0.47)	(0.57,0.78,1)	(0.42,0.55,0.82)
T	(0.08,0.10,0.15)	(0.07,0.09,0.12)	(0.15,0.15,0.15)	(0.10,0.12,0.14)

Table 5. Comparing Matrix of the relative weight of each factor and opportunities criteria with incompatibility rate of 0.076

	S	W	T	Mean
S	(1,1,1)	(0.60,0.80,1)	(0.68,0.84,1)	(0.76,0.88,1)
W	(0.12,0.15,0.20)	(0.12,0.12,0.12)	(0.28,0.48,0.68)	(0.17,0.25,0.33)
T	(0.12,0.14,0.17)	(0.02,0.03,0.05)	(0.12,0.12,0.12)	(0.08,0.09,0.11)

Table 6. Comparing Matrix of the relative weight of each factor and threats criteria with incompatibility rate of 0.066

	S	W	O	Mean
S	(0.46, 0.46, 0.46)	(0.45,0.70,0.95)	(0.32,0.59,1)	(0.41,0.58,0.80)
W	(0.07,0.10,0.15)	(0.15,0.15,0.15)	(0.10,0.138,0.19)	(0.10,0.12,0.16)
O	(0.32,0.54,1)	(0.52,0.76,1)	(0.69,0.69,0.69)	(0.51,0.66,0.89)

Table 7. Comparing Matrix of the strength sub factors, regardless of the relationship between the sub factors with incompatibility rate of 0.845

	S_1	S_2	S_3	S_4	S_5	S_6	Weighting of criteria
S_1	(1,1,1)	(0.42,0.71,1)	(0.54,0.77,1)	(0.64,0.83,1)	(0.49,0.8,1)	(0.56,0.79,1)	(0.65,0.82,1)
S_2	(0.23,0.33,0.55)	(0.23,0.23,0.23)	(0.37,0.58,0.78)	(0.38,0.58,0.79)	(0.3,0.45,0.6)	(0.24,0.56,0.58)	(0.30,0.43,0.59)
S_3	(0.13,0.17,0.25)	(0.04,0.05,0.08)	(0.13,0.13,0.13)	(0.22,0.34,0.47)	(0.11,0.17,0.23)	(0.14,0.33,0.48)	(0.13,0.17,0.23)
S_4	(0.12,0.15,0.20)	(0.03,0.05,0.07)	(0.03,0.05,0.07)	(0.12,0.12,0.12)	(0.05,0.09,0.14)	(0.06,0.17,0.22)	(0.08,0.09,0.12)
S_5	(0.14,0.2,0.36)	(0.24,0.08,0.45)	(0.28,0.47,0.08)	(0.35,0.22,0.54)	(0.28,0.25,0.36)	(0.21,0.17,0.23)	(0.25,0.28,0.42)
S_6	(0.14,0.22,0.87)	(0.03,0.05,0.07)	(0.13,0.13,0.13)	(0.35,0.64,0.49)	(0.19,0.16,0.26)	(0.24,0.23,0.10)	(0.19,0.16,0.26)

Table 8. Comparing Matrix of the weakness sub factors, regardless of the relationship between the subfactors with incompatibility rate of 0.845

	W_1	W_2	W_3	W_4	W_5	W_6	Weighting of criteria
W_1	(1,1,1)	(0.38,0.68,1)	(0.52,0.73,0.94)	(0.73,0.77,1)	(0.46,0.71,1)	(0.41,0.79,1)	(0.63,0.81,0.98)
W_2	(0.20,0.29,0.52)	(0.2,0.2,0.2)	(0.55,0.71,1)	(0.38,0.59,0.76)	(0.22,0.43,0.8)	(0.30,0.36,0.54)	(0.33,0.46,0.62)
W_3	(0.13,0.20,0.27)	(0.02,0.03,0.05)	(0.14,0.14,0.14)	(0.33,0.44,0.47)	(0.17,0.14,0.24)	(0.24,0.23,0.10)	(0.15,0.20,0.26)
W_4	(0.13,0.15,0.22)	(0.03,0.04,0.07)	(0.03,0.04,0.06)	(0.13,0.13,0.13)	(0.03,0.07,0.24)	(0.26,0.37,0.12)	(0.08,0.10,0.12)
W_5	(0.14,0.22,0.36)	(0.04,0.08,0.08)	(0.08,0.07,0.28)	(0.05,0.02,0.33)	(0.02,0.02,0.26)	(0.07,0.09,0.12)	(0.07,0.09,0.12)
W_6	(0.13,0.25,0.42)	(0.11,0.21,0.14)	(0.13,0.17,0.25)	(0.09,0.14,0.25)	(0.14,0.15,0.19)	(0.13,0.14,0.2)	(0.11,0.21,0.14)

Table 9. Comparing Matrix of the opportunity sub factors, regardless of the relationship between the subfactors with incompatibility rate of 0.845

	O_1	O_2	O_3	O_4	O_5	O_6	Weighting of criteria
O_1	(1,1,1)	(0.43,0.79,1)	(0.57,0.78,1)	(0.41,0.67,1)	(0.53,0.52,1)	(0.52,0.46,1)	(0.57,0.78,1)
O_2	(0.19,0.27,0.45)	(0.19,0.19,0.19)	(0.25,0.37,0.54)	(0.39,0.59,0.76)	(0.41,0.54,0.71)	(0.26,0.39,0.48)	(0.39,0.59,0.76)
O_3	(0.30,0.41,0.62)	(0.10,0.15,0.22)	(0.30,0.30,0.30)	(0.38,0.55,0.73)	(0.31,0.57,0.84)	(0.33,0.46,0.44)	(0.28,0.40,0.54)
O_4	(0.13,0.16,0.22)	(0.03,0.04,0.06)	(0.05,0.07,0.10)	(0.13,0.13,0.13)	(0.36,0.42,0.52)	(0.14,0.17,0.12)	(0.14,0.16,0.21)
O_5	(0.26,0.38,0.64)	(0.07,0.09,0.12)	(0.09,0.14,0.25)	(0.06,0.08,0.09)	(0.26,0.26,0.26)	(0.19,0.18,0.29)	(0.15,0.19,0.27)
O_6	(0.04,0.05,0.07)	(0.16,0.17,0.18)	(0.15,0.16,0.19)	(0.19,0.16,0.26)	(0.14,0.15,0.21)	(0.17,0.18,0.23)	(0.17,0.18,0.23)

Table 10. Comparing Matrix of the threat sub factors, regardless of the relationship between the sub factors with incompatibility rate of 0.845

	T_1	T_2	T_3	T_4	T_5	T_6	Weighting of criteria
T_1	(1,1,1)	(0.58,0.79,1)	(0.71,0.91,0.94)	(0.54,0.78,1)	(0.53,0.83,1)	(0.69,0.77,1)	(0.71,0.87,1)
T_2	(0.12,0.16,0.21)	(0.12,0.12,0.12)	(0.47,0.64,0.82)	(0.34,0.48,0.64)	(0.48,0.51,0.76)	(0.43,0.61,0.79)	(0.27,0.36,0.45)
T_3	(0.14,0.15,0.20)	(0.22,0.28,0.05)	(0.14,0.14,0.14)	(0.13,0.21,0.30)	(0.15,0.17,0.21)	(0.24,0.27,0.19)	(0.11,0.13,0.17)
T_4	(0.13,0.16,0.22)	(0.03,0.04,0.06)	(0.05,0.07,0.10)	(0.13,0.13,0.13)	(0.36,0.42,0.52)	(0.14,0.17,0.12)	(0.09,0.10,0.14)
T_5	(0.13,0.21,0.20)	(0.17,0.16,0.22)	(0.19,0.14,0.18)	(0.19,0.16,0.21)	(0.26,0.26,0.26)	(0.09,0.08,0.12)	(0.19,0.26,0.26)
T_6	(0.18,0.27,0.41)	(0.19,0.23,0.18)	(0.13,0.16,0.26)	(0.13,0.17,0.28)	(0.17,0.16,0.24)	(0.17,0.17,0.17)	(0.19,0.23,0.26)

Step 7. In this step, alternative strategies are prioritized using a paired comparison matrix. The results were calculated using the Expert Choice Software.

Then the relative weights obtained from the analysis of paired comparisons tables for ranking the alternatives (W) are calculated.

Step 8. Finally, according to the following formula, the final weight of alternative strategies is calculated:

$$W_A = W \times W_G \quad (6)$$

In this formula:

W_A is the final weight of alternative strategies. W is the degree of prioritizing alternative strategies, with respect to each of the sub factors of SWOT. W_G is the total weight of sub factors. The results of these calculations are shown in Table 11:

Table 11. The final weight of alternative strategies

	W	W_G	W_A
SO	0.358136	0.594208	0.948580
ST	0.486116	0.729462	0.975622
WO	0.167845	0.297004	0.494398
WT	0.249607	0.388698	0.675449

Based on the achieved weight, ST Strategy is the highest weight. Therefore, the best strategy for implementation are ST Strategy. These strategies are as follows:

ST1. Consensus on research priorities and creating a shared vision for the future

ST2. Explicit decisions to expand or change of research program.

ST3. Design Action Plan.

ST4. Definition and implementation of future studies for appropriate infrastructure. Also the optimal relationship between the network of experts in the country and abroad with an emphasis on new technologies and future technologies.

ST5. Selecting an independent organization as trustee of future studies projects.

ST6. Dissemination the future information, in terms of public education.

5. Conclusions and suggestions

Future studies have created the three areas of knowledge: futurism, strategic planning, and policy development and networking. Since the successful implementation of future studies depended on the participation of various stakeholders and policy makers and experts is possible, costs can be reduced with balancing and gain competitive advantage. Finally, in long term, it will lead to sustainable development. In today's world it is accepted that the IT industry is key propulsion of economic growth and it is necessary to consider the dynamics of information technology. For this reason, policymakers must recognize new trends and use in the IT industry. These trends are used to achieve the dynamics of information technology. To achieve this goal, the SWOT matrix is used.

The purpose of using this matrix in the process of strategic management is the decision support is applied in strategy selection. However, its application alone does not provide the effective and useful information for decision-makers. Therefore, incorporation of Multi Criteria Decision Model on the one hand and fuzzy logic on the other hand , can provide the useful framework for strategic position analysis and selection of appropriate strategies. It can also improve and upgrade the basis of strategic planning processes. This paper, using the method of Fuzzy ANP in SWOT matrix has provided the following benefits for members of the strategic team:

1. Eliminating the inaccurate and uncertainties inherent in strategic management process.
2. Measuring the impact of each SWOT factors on the strategies developed.
3. Measuring the correlation between strategic factors.

Other studies, in addition to the assumption of independence among the main factors of strategy, can also examine the dependence of the subfactors. Also, in cases where the paired comparison matrix is uncertainty, researcher can use the fuzzy numbers. Combining SWOT and Fuzzy MCDM on the other sectors such as marketing, financial, manufacturing, etc. can be used.

References

Darkow. I. L., 2014, The involvement of middle management in strategy development - Development and implementation of a foresight-based approach, Technological Forecasting and Social Change 28, In Press, Corrected Proof, doi:10.1016/j.techfore.2013.12.002.

Dincer. O., 2004, Strategy Management and Organization Policy, Istanbul: Beta Publication.

Gaoa. T., Guptaa. A., Gulpinarb. N. and Zhu. Y., 2015, Optimal hedging strategy for risk management on a network, Journal of Financial Stability 16, pp. 31–44.

Granell. X., 2015, A strategic approach to adopt ICT: from using information and communication technology to making use of information and technology to communicate, Multilingual Information Management Information, Technology and Translators, pp. 45–59.

Gratton. L., HopeHailey. V., Stiles. P. and Truss. C., 1999, Linking individual performance to business strategy: The people process model, Human Resource Management 38, pp. 17-31.

Kahraman. C., Ertay, T. and Buyukozkan. G., 2006, A fuzzy optimization model for QFD planning process using analytic network approach, European Journal of Operational Research 171, pp. 390-411.

Kangas. J., Kurtila. M., Kajanus. M. and Kangas. A., 2003, Evaluating the management strategies of a forestland estatethe SOS approach, Journal of Environmental Management 69, pp. 349-358.

Kaviani. M. A. and Abbasi. M., 2014, Analyzing the operations strategies of manufacturing firms using a hybrid Grey DEA approach – A case of Fars Cement Companies in Iran, International Journal of Supply and Operations Management, Volume 1, Issue 3, pp. 371-391.

Keenan. M. 2002, Identifying emerging generic technologies at the national level: the UK experience. Journal of Forecasting.

Keenan. M., 2003, Technology Foresight: An Introduction, Technology Foresight for Organizers, Ankara, Turkey; pp. 8-12.

Krejcie. R. and Morgan. D., 1970, Determining sample size for research activities, Educational and Psychological Measurement 30, pp. 607-610.

LengnickHall. C. and LengnickHall. M., 1998, Strategic human resources management: a review of the literature and a proposed typology, Academy of Management Review 13, pp. 70-454.

Mahdavi. I, Fazlollahtabar. H., Paydar. M. M and Heidarzade. A., 2008, Applying Multi-Criteria Decision Methods and SWOT Factors to Analyze the Role of Information Technology in Industry Development in Iran, Journal of Applied Sciences, Volume: 8, Issue: 17, Page No: 2983-2990. DOI: 10.3923/jas.2008.2983.2990

Manteghi. M., Abdi. B., Tofigh. A. A., 2011, Technological Vision in Automotive Industry and Presenting a Model for the Iranian Automotive Industry, International Journal of Automotive Engineering 1 (3), pp. 197-205.

Nyiri. L., 2003, Foresight as a policy-making tool, Technology Foresight for Organizers, Unido text book.

Rodriguez. J. M. and Ventura. J., 2003, Human resource management systems and organizational performance: an analysis of the Spanish manufacturing industry, International Journal of Human Resource Management 14 (7), pp. 1206-26.

Safari. E., Babakhani. M., Sadjadi. J., Shahanaghi. K. and Naboureh. K., 2014, Determining strategy of pricing for a web service with different QoS levels and reservation level constraint, Applied Mathematical Modelling, In Press, Corrected Proof, doi:10.1016/j.apm.2014.11.054.

Saniee. M., 2015, Role of ICT in Sustainable Urban Development by Using Model SWOT, International journal of Advanced Biological and Biomedical Research, Volume 3, Issue 1, Article 16, pp. 82-86.

Santos. M., Santos. D. M., Filho. L. F., Coehlo. G. M. and Zackiewicz. M., 2004, Adding Value to Information in the Process of Promoting Technological Innovation: an approach Implemented by the Center for Management and Strategic Study on Science, Technology and Innovation in Brazil. Center for Management and Strategic Study (CGEE) and University of Companies (UNICAMP).

Xie. S. L., 2013, National strategy for digital records: Comparing the approaches of Canada and China, International Journal of Information Management 33 (4), pp. 697–701.

Yaghoubi-Farani. A., Gholinia. J. M and Movahedi. R., 2011, Analyzing Strengths, Weaknesses, Opportunities, and Threats of Rural ICT Development in Iran's Villages, International Journal of Agricultural Science, Research and Technology 1 (1), pp. 17-26.

Yuksel. E. and Dagdeviren. M., 2007, Using the analytic network process in a SWOT analysis: A case study for a textile firm, Information Science 177, pp. 3364-3382.