A Study of the Entrepreneurial Success Index (ESI) in the Development of Industrial Plants Using MCDM Method

By

[1]Hamid Gharzi, [2]Younos Vakilalroaia, [3]Mojtaba Javidnia and [4]Amir Hossein Moravveji

[1]Faculty Member, Department of Management, Sabzevar Branch, Islamic Azad University, Sabzevar, Iran, E
[2]Assistant Prof. and Chairman, Department of Management, Semnan Branch, Islamic Azad University, Semnan, Iran
[3]Faculty Member, Department of Management, Sabzevar Branch, Islamic Azad University, Sabzevar, Iran
[4]Master Student of Industrial Management, Semnan Branch, Islamic Azad University, Semnan , Iran

Abstract

The purpose of this research is to identify and rank the factors affecting the entrepreneurial success in the development of industries. The dramatic and widespread changes happening every day in every aspect of social life and even in values and cultures governing the societies have caused entrepreneurship to be recognized as an effective strategy for the economic and social development of countries. With regard to the importance of industries in the economic development of a country, in this study, we deal with evaluating and ranking entrepreneurial success index (ESI) for the development of industries in Semnan Province in 2010. After reviewing the related literature and enjoying the comments given by experts in entrepreneurship field, thirteen major ESI were identified in the industrial sector. Then, having recourse to the professional comments, the interactions of each index on one another were specified. Using DEMATEL method the indexes were categorized into two active and passive groups. Later, the most active and the most passive ESI in the industrial sector were identified. In addition, using Analytic Network Process (ANP) method, the weights relevant to each index were specified and finally through the Vikor method, the final indexes were ranked. Results obtained from the final ranking suggest that "innovation, creativity and idealization" are among the most important factors in this category. Further, "being pragmatic" was introduced as the least important factor among the set of factors affecting ESI in terms of industrial development.

Key words: *Entrepreneurship, Development, Iranian industries, ESI, DEMATEL, ANP, VIKOR Method*

1. Introduction

Entrepreneurship and innovation have always been regarded as one of the major factors when it comes to the competition of national industries so that they affect the structure, process, products and the strategic growth of the active companies in industry and finally the national development (Gunday et.al. 2011). The research conducted on the industries of various countries suggest the fact that entrepreneur companies active in industrial sector play a major and crucial role in the economic development of the country (Javalgi et.al.,2011). In addition, the evidence showed that wonderful results and achievements have been obtained from the industries in which entrepreneurship patterns and strategies have been implemented successfully and the results have changed both the political and economic poles, created modern economic blocks and redefined many important concepts (Hosseini, 2009).

Policymakers and economists approach toward the entrepreneurship for the promotion of productivity, using opportunities and potentialities, targeting at employing wandering capitals toward innovative strategies. In addition, the entrepreneurs are considered as confident persons (Mamat &Raya, 1990), ambitious (Jaafar et.al, 2004), industrious and independent (Chen et.al, 2005), stakeholder (Mullins & Forlani, 1998), possessing the ability of learning from frustrations (Shephered et.al, 2008), who create widespread changes and fundamental revolutions in many areas of concern.

The entrepreneurial economics in comparison with other types of economy surpasses the strategies such as creating productive and effective employment, immobilization of the economic practice, transferring

and employing emergent technologies, improving many economic indexes and the replacement of modern patterns which these superiorities caused to be considered as one of the most effective and appropriate models for the necessities, conditions and challenges facing various countries and developing economies. The economists contend that economic problems and situations in some countries originate from the lack of engagement of all the economic factors, a low level of productivity, ignoring new opportunities, paying no attention to the emerging technologies, unemployment of all the potential laborers and human forces as well as other problems.

The identification of the indexes and factors affecting the entrepreneurship promotion is regarded as economic advancement tools for the achievement of success, particularly in developing countries. According to the global statement of entrepreneurship, there is a strong correlation between the national economic growth and the organizational and national entrepreneurial activity (Jennifer & vakili, 2008).

Therefore, with regard to the vital importance and undeniable necessity of entrepreneurship for the development and flourishing economy in each country, the role of entrepreneurial success indexes (ESI) in the development of industrial plants in one of the Iranian industrial poles in 2010 are examined and ranked in this study.

2. Literature Review

Today, entrepreneurship has been identified as an effective strategy for the economic and social development of countries. By entrepreneurship we mean the process of exploring and providing opportunities in order to create values in the various economic, social and cultural fields and are considered fundamental to the sustainable development. Thus, entrepreneurship development plays a deserving role for the active attendance in the global market, competition with competitors, providing sustainable employment, development of justice, reducing poverty and solving the problems of society, government and public sectors. Entrepreneurship has always been an essential part to the changes and advancements of human beings and defined in a variety of ways. Sociologists, psychologists, economists, and management scholars have presented different definitions for entrepreneurs. However, most definitions share the fact that entrepreneurs are the axis of economic development and through the replacement of modern and effective methods in the economic system with ineffective and old methods give life to the economic system. Entrepreneurship is as an important and major factor for the development. The reinforcement and the growth of entrepreneurship, is regarded as one of the fundamental actions which shall be performed for facilitating social and economic development (op cit. et.al, 2011). Undoubtedly, the trend of economic development in the developed countries represents that economics is affected by entrepreneurship and entrepreneurs play a pivotal role in the economic development of the developed countries.

Global economics is creating basic changes for the organizations and industries around the world. These changes force commercial firms to scan their targets precisely and pay due attention to the selection as well as following strategies resulting in the levels of activities with high degree of success for many beneficiaries. Many of the companies established in response to the quick and dramatic changes created in the internal and external environments have devised a foundation for the structure of their operations (Mostafavi, 2011). In fact, the new century witnesses the emphasis of the companies on entrepreneurship. This modern approach toward the entrepreneurial thought was developed along with entrepreneurial economics in 1980s and 1990s (Histerich & Pizer, 2005) and since then we have witnessed the stronger and more fundamental role of entrepreneurship as one of the key elements of economic success in every country.

So far, remarkable studies have been conducted on the importance of entrepreneurship in the industries of the various countries (Jaafar et.al, 2011). Some are listed as follows:
Table1. Researches on the importance of entrepreneurship in industry

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No.	Article title	Author/year	Findings
1	Effects of innovation types on firm performance	Gunday et.al, 2011	The purpose of this article is to elaborate on the effects of procedural, manufacturing and marketing organizational innovations on the firm performance. To achieve such a goal, a study was done on 184 firms in Turkey. The findings indicate the positive effects of innovation on the performance of firms in manufacturing industries.
2	Entrepreneurial orientation, management commitment, and human capital: The internationalization of SMEs in India	Javalgi, et.al, 2011	This study which bases on the data gathered from 150 small scale and medium scale companies in India recognizes the entrepreneurial behavior, firm sources, management commitment and high capability of human capital as factors of success in the industry of India.
3	Entrepreneurship, windfall gains and financial constraints: Evidence from Germany	Schafer et.al,2008	In this article, the financial constraints of some German firms are considered as underlying elements of entrepreneurial activities to apply new ideas for higher windfall gains.
4	The realization of tourism business opportunities adjacent to three national parks in southern Finland: entrepreneurs and local decision-makers matter	Selby et.al, 2011	The results of this study show that development of tourism business opportunities in three national parks in Finland are affected by entrepreneurial attitudes and economic preferences of the local decision makers.
5	Entrepreneurship policy evaluation and decision analysis for SMEs	Tsai & Kuo, 2011	This article is a compound model consisting of DEMATEL, ANP and ZOGP methods. This combination model is able to indicate the relationships between the evaluation criteria and the strategies well and eliminates the limitation of annual budget very well. This model as an experimental study in order to evaluate the entrepreneurial policies in small and medium scale companies in Taiwan have been used. the results of evaluation indicated that three strategies with regard to budget limitation can be selected as the best strategy . therefore, this combination model, is an effective method for assisting the decision makers to evaluate and selection of the best policy of entrepreneurship for small and medium scale companies in Taiwan.
6	Delivering enterprise A collaborative international approach to the development, implementation and assessment of entrepreneurship	Smith & Paton, 2011	The goal of this study is to examine and assess an innovative approach for the development, implementation and evaluation of entrepreneurship in companies. This research was conducted between 2006-2008 in Scottish firms and its purpose is to evaluate the entrepreneurial skills transferrable among managers and firms.
7	Applying the IPA and DEMATEL models to improve the order-winner criteria: A case study of Taiwan's network communication equipment manufacturing industry	Huang et.al,2011	The purpose of this study is to analyze the ESI in small and medium scale firms in Taiwan. Finally, the investment index was regarded as the most important index in successful application of entrepreneurship in companies.
8	Factors influencing technological entrepreneurship capabilities Towards an	Petti & Zhang,2011	The goal of this research is to seek and evaluate the factors affecting the entrepreneurial capabilities in Chinese companies. In order to achieve this aim a number of internal and external factors which are

	integrated research framework for Chinese enterprises		interrelated and affect the entrepreneurial capabilities of Chinese companies were recognized and evaluated.
9	Identification of domains for a new conceptual model of strategic entrepreneurship using the configuration approach	Kraus et.al,2011	The aim of this analysis is to synthesize and apply researchers' approaches in the field of strategic entrepreneurship to create a theoretical model. Considering this and reviewing the background literature, four different concepts concerning strategic entrepreneurship based on positional approach have been identified which include strategy, entrepreneur, environment and structure and sources of the company. The results suggest that this new approach can considerably contribute to the strategic managers in order to implement the entrepreneurship effectively.
10	Personal characteristics and strategic orientation :entrepreneurs in Canadian manufacturing companies	Zhang & Bruning,2011	The results of this study indicate that individual characteristics of entrepreneurs have positive and fundamental effect on the performance of firms. The data used in this study were gathered through distribution of questionnaires among the owners and senior managers of the small and medium scale companies in Canada and the relationship among the indexes was performed using regression analysis. Some individual characteristics of entrepreneurs such as endeavor to achieve success, endeavor to recognize and realize the issues and internal control are the most important factors which had positive effect on the firm performance.
11	The strategic entrepreneurial growth model	Shulman et.al,2011	The purpose of this study is to present a unique strategic entrepreneurship model and a strategy for success of big companies through creating entrepreneurship spirit and utilization of mental and intellectual capitals.

3. Materials and Methods

Population
Among the Iranian industries, one of the most important industrial poles has been studied in order to evaluate the entrepreneurial success Index. For this purpose, one hundred companies located in Semnan Province ranked as the highest companies in terms of economic growth during the previous year-according to Organization for Industries and Mines- have been selected as the statistical population.

Sampling
With regard to Morgan Sampling Table and the statistical population, statistical sample in this study are composed of 80 people. The following is a sample of Morgan Table:

Table 2: Morgan Sampling Table

Population	Sample
90	73
95	76
100	80
110	86
120	92

Validity and Reliability of the Questionnaire

In this study, this method was used for examining the validity of a questionnaire. Therefore, the questionnaire was sent to a number of entrepreneurship experts to analyze and certify the accuracy of the questions. The reliability of the study was determined by α Kronbach as in the following formula:

$$r_\propto = (\frac{k}{k-1})(1 - \frac{\sum \sigma_j^2}{\sigma^2})$$

In this relation, r_α is the reliability coefficient of the whole test, k is the number of questions (chapters) of the test, σ_j^2 variance of the total question score (chapter), j $\cdot \sigma^2$ variance of the total score of the questions (test). It is said that if the coefficient is more than 0.7, the test will show an acceptable reliability. In this study, the reliability coefficient equals to 0.86 which shows an optimal reliability.

The entrepreneurial success index in the development of industrial plants

In this study, primarily using the industries and various entrepreneurial resources and also articles dealing with entrepreneurship, the ESI extracted and employed Delphi method and experts' and authorities' opinions, these indexes were refined and actually 13 main indexes were specified for the research which these indexes are demonstrated in the following table (3):

Table 3: ESI in the development of industries in Semnan Province

Index no.	Index title
X_1	Being pragmatic
X_2	Need to achievement
X_3	Possessing internal focus of control
X_4	Tendency to risk taking
X_5	High tolerance of ambiguity
X_6	Confidence
X_7	High perseverance
X_8	Being idealistic
X_9	Innovation, creativity, idealization
X_{10}	Being realistic and loyal to promise
X_{11}	Being opportunistic (more seek opportunities than threats)
X_{12}	Being futuristic
X_{13}	Being self dependent

DEMATEL technique:

DEMATEL technique was introduced for the first time in an institute affiliated to Battelle Research Institute in Geneva (Fontela & Gabs, 1976). At this time, this method was applied in the complicated researches around the world such as famine, energy, environmental preservation, etc. (Fontela &Gabus, 1976; Gabus &Fontela, 1973). DEMATEL is one of the multivariate decision making tools with the ability of changing the qualitative plans to quantitative analyses (Lee et al., 2011). This approach was established based on a structural model with a cause and effect diagram which specifies the relationships between the factors and the degree of their affectability. The basis of this method is graph theory (Chen & Chen, 2010; Zhou, Huang & Zheng, 2011). The purpose of DEMATEL is to change the relationship among the criteria/dimensions cause and effect, from a complicated system to a structural model understandable from that system (Hue et al., 2011; Dalalah et.al, 2011) developed through creating a relationship plan of network NRM among the landscapes and criteria (Tzeng et.al, 2007).

As a matter of fact, in a general interactive system, all the criteria of the system are interrelated both directly and indirectly. Therefore, each change in one criterion will affect the other criteria (Tzeng et.al.2007). Through this method all the factors of the system are categorized into two sets of active and passive categories and the researchers will be able to realize the structural relationships of the system elements and in order to solve the problems of the complicated systems; solutions shall be sought (Zhou et.al, 2010). This technique has been successfully applied in many situations such as the development methods, systems of management, evaluation of e-learning, management of knowledge, etc. (Zhou et.al.,2010; Lin and Hsieh,2010; Hung,2011; Lin et.al.,2011; Kuoa, Liang,2011).

In the recent years, Japan, Korea and Taiwan have used DEMATEL method in order to solve various problems in different fields successfully. Dematel procedures are as follows (Opricovic & Tzeng, 2004):
Step 1: selection of the scale in order to compare the criteria. Table 4 shows the scale of comparison.

Table 4: DEMATEL scales of comparison

description	Number
Ineffective	0
Low effect	1
Medium effect	2
High effect	3
Very high effect	4

Step 2: performing pair-wise comparisons and preparing matrices of direct relationships in this procedure, primary matrices (A) are obtained based on the rate of relationship and the effect of each criterion on one another and through pair-wise comparisons.
Step three: obtaining normalized matrix (x)
Using formulae (10 and 92) Matrix (x) is obtained.

(1) $$X = s \cdot A$$

(2) $$s = \frac{1}{\max\limits_{1 \leq i \leq n} \sum\limits_{j=1}^{n} a_{ij}}$$ $\quad (i, j = 1, 2, ..., n)$

Step four: the calculation of matrix of the general relationship (T)
After the calculation of normalized matrix (X), the general –relationship matrix (T) is obtained through the relationship (3). In this relationship, the matrix (I), is the identity matrix.

(3) $$T = X(I - X)^{-1}$$

Step five: studying the results of cause and effect groups
Calculation of D-R and D+R values through applying relations (4), (5) and (6). While R is the sum of the columns and D are the total rows. With regard to the values obtained, some criteria have higher positive values from D-R which in fact suggest that have a higher effectiveness on other criteria. Thus, they hold a higher priority in relation to others and they are called cause group. Those which have negative values have higher rate of effectiveness and lower priority and therefore they form the effect group. (4)

(4) $$T = t_{ij} \quad (i, j = 1, 2, ..., n)$$

$$(5) \quad D = \sum_{j=1}^{n} t_{ij}$$

$$(6) \quad R = \sum_{i=1}^{n} t_{ij}$$

Step six: drawing the plan of relations

By the values obtained through D-R and D+R the plan of relations in order to make the internal relationships transparent and the degree of effectiveness and the rate of passiveness of the criteria (Opricovic & Tzeng, 2004).

Analysis Network Process (ANP)

The ANP method procedures are as follows (Lee et.al, 2008)

The first step: creating a network configuration

In this phase, the decision making should be defined clearly and analyzed into the networks. This structure can be considered through brainstorming sessions and other analysis methods which shall be achieved by the decision making group.

Components/ important factors affecting the decisions shall be identified. After defining the decision goals, the categories shall be analyzed into subsidiary components such as criteria group (goals), subsidiary criteria group (evaluation factors), and options group. Therefore, each element in the category can communicate weight other elements in the system (Saaty, 1996). The purpose of this framework is to identify options which shall be regarded in detecting the best ESI applied. In other words, in this stage, the criteria options of decision making are selected.

Step two: performing pair-wise comparison:

In order to specify the relationship among the elements, the decision making team shall respond to the pair-wise comparison questions. These comparisons are based on the scale of 0-9 hours. This scale shows the degree of importance of one element over the other. Number one expresses the equal degree of importance of two elements in connection with one another and number nine is the highly importance of one in relation to other elements (Liou et.al, 2007). All the relationships among the elements in each network shall be formulated and the following comparison is performed for the calculation of special vectors:

Group comparisons: Pair-wise comparisons of the groups affecting a presented group, with regard to the control measure for that network. The values obtained through this process for the assessment of the elements will be used in the blocks of the column opposite to super matrix for the network.

Comparison of the elements: Pair-wise comparison inside the groups.
The elements inside a group are compared according to their effect on an element in another group which is in connection with one another.

Comparison of the options: The options are compared with regard to the elements which are in relation to one another. After the completion of the pair-wise comparisons the special vector W is applied to estimate the relative importance of the elements. For this purpose, the following equation is used. λ_{max} is the highest eigen value pair-wise comparison of the matrix A.

(1) $AW = \lambda_{max} W$

The third step: Formation and analysis of the super-matrix

A super matrix in fact is a classified matrix so that each sub-matrix indicates the relationship between two particular clusters. As it can be seen in the following figure W_S is a matrix which shows the weights of active standard cluster in relation to decision clusters. W_C is a matrix which includes the weights of passive standard cluster. And W_A is a matrix which offers the weights of decision cluster in relation with the passive standard.

$$W = \begin{array}{c} \text{Cause criteria} \\ \text{Effect criteria} \\ \text{Alternatives} \end{array} \begin{pmatrix} 0 & 0 & W_S \\ W_C & 0 & 0 \\ 0 & W_A & 0 \end{pmatrix}$$

Super-matrix (Wu, 2008)

In this method after the development of the comparison matrix the special vector is obtained. The matrix of the comparison become normal and the average amount of each level of matrix as the criteria weight in question in the special vector is used. Summing the special vectors up obtained because of element comparison in a matrix the inharmonic special matrix is obtained. After the calculation of the inharmonic special matrix, some columns may be in the form of probable columns and/or simpler. The sum of the elements of the columns is not equal to one. In this case, we cannot say that the final effect is the controlling in question over all the elements are shown accurately. In order to prevent this state through multiplication of normalized values corresponding to each criterion in relation with their effect and the final normalizing of the columns, the special matrix is obtained.

When drawing a network of the elements and the clusters some effects directly are drawn. But there are some hidden effects in a network of correlations which they are not drawn due to lack of direct relation. Therefore, on the harmonic special matrix changes shall be applied so that all the effects can be revealed. In other words, they should be modified. When there is a direct relationship between two criteria in relation to controlled criteria, then the effect is applied directly in harmonic special matrix. But in case that the criteria affect directly, criteria b and b in turn affects criteria c and there is no the effect of an on c in the harmonic special matrix. In order to achieve this effect the special harmonic matrix is squared. And in case those two criteria are interconnected through two more criteria for obtaining this effect the harmonic matrix is cubed. For the calculation of limited matrix, it is sufficient to multiply the harmonic special matrix frequently so that a level of stability can be reached (Saaty & Vargas, 2006).

Step four: selecting the best decision option:

Through calculation of the decision making weights, options and prioritizing them, we can choose the highest weight with the highest priority as the superior option. But we should notice that the final response of ANP is not necessarily an optimal response.

VIKOR: The VIKOR method procedures are as follows (Chang & Hsu, 2009).

1. Calculation of F_{ij} and specifying the highest (F_i^*) and the lowest (F_i^-) value of all criteria and i=1, …,n.

   F_{ij}, is the value of ith criteria for the option of x_j.

   $f_i^* = \max [(f_{ij}) | j=1,2,…,m]$

$f_i^- = \min \ [(f_{ij}) \ |j=1,2,\ldots,m]$

………….

2. Calculation of S_j and R_j and $j=1,2,\ldots,m$ which S_j and R_j show the degree of desirability and undesirability of the option x_j respectively.

$S_j = \Sigma \ w_i(f_i^* - f_{ij}) \ / \ (f_i^* - f_i^-)$

$R_j = \max \ [w_i(f_i^* - f_{ij}) \ / \ (f_i^* - f_i^-) \ |i=1,2,\ldots,n]$

W_i also shows the weight of each criterion.

3. Calculation of Q_j and $j=1,2,\ldots,m$.

$Q_j = v(S_j - S^*) \ / \ (S^- S^*) + (1 - v) \ (R_j - R^*) \ / \ (R^- - R^*)$

$S^* = \min[(S_j) \ | \ j=1,2,..,m]$

$S^- = \max[(S_j) \ | \ j=1,2,..,m]$

$R^* = \min[(R_j) \ |j=1,2,\ldots,m]$

$R^- = \max \ [(R_j) \ |j=1,2,\ldots,m]$

4. Ranking options based on the values index – Q_j the lowest value of Q_j is the bets decision option.

4. Empirical Results

Specifying the active and passive indexes through DEMATEL method

After specifying the main indexes of research in the previous stage, the interaction questionnaire of these indexes have been distributed among the senior managers of the companies under study. And then through completing the distributed questionnaire by eighty managers of the active companies in the industrial companies of Garmsar city, the primary matrix (A) based on the rate of relationship and the effect of each criterion on one another and through average pair comparison was obtained as in the table (5).

Table 5: Primary Matrix

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	
X_1		3.3	2.4	3.2	2.3	2.4	1.7	2.4	1.6	1.8	2.3	1.6	2.2	27.2
X_2	2.5		2.4	3.2	2.6	3.4	2.8	3.4	3.2	2.4	3.6	2.4	3.8	35.7
X_3	1.7	2.2		2.9	3.2	2.4	1.8	2.7	2.5	1.9	2.4	2.6	3.3	29.6
X_4	1.4	3.4	2.6		3.4	2.6	2.4	2.6	2.9	1.6	3.7	3.4	3.6	33.6
X_5	2.4	2.6	3.4	1.7		1.8	2.6	2.4	1.6	2.6	2.4	3.6	1.4	28.5
X_6	3.2	2.9	2.6	3.2	3.4		2.6	1.7	2.4	1.6	2.6	2.4	3.2	31.8
X_7	1.4	3.8	2.6	3.4	2.7	1.6		2.6	3.8	3.8	2.7	2.6	3.4	34.4
X_8	1.6	3.5	1.4	2.6	2.4	1.9	2.8		2.4	1.6	2.4	3.8	3.4	29.8
X_9	1.6	3.2	3.4	2.6	3.4	2.8	3.2	3.3		3.6	3.1	2.9	3.4	36.5
X_{10}	1.3	3.2	2.4	2.2	1.6	2.1	3.6	1.3	3.4		2.3	2.1	2.5	28
X_{11}	3.2	2.4	3.2	3.6	3.1	3.2	2.4	3.3	2.4	2.2		2.3	3.4	34.7
X_{12}	3.2	1.8	2.8	1.7	2.8	2.3	3.2	1.8	2.4	3.3	2.1		2.3	29.7
X_{13}	3.7	2.9	3.2	3.4	3.6	3.1	2.8	2.6	2.2	2.6	3.4	2.6		36.1
	27.2	35.2	32.4	33.7	34.5	29.6	31.9	30.1	30.8	29	33	32.3	35.9	

Subsequently, and with regard to the primary matrix obtained the comments given by the experts, the normalized matrix (X) and general relationship Matrix (T) were obtained as in the tables 6 and 7.

Table 6: Normalized Matrix

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
X_1		0.090411	0.065753	0.087671	0.063014	0.065753	0.046575	0.065753	0.043836	0.049315	0.0630 13699	0.043836	0.060274
X_2	0.068493		0.065753	0.087671	0.071233	0.093151	0.076712	0.093151	0.087671	0.065753	0.0986 30137	0.065753	0.10411
X_3	0.046575	0.060274		0.079452	0.087671	0.065753	0.049315	0.073973	0.068493	0.052055	0.0657 53425	0.071233	0.090411
X_4	0.038356	0.093151	0.071233		0.093151	0.071233	0.065753	0.071233	0.079452	0.043836	0.1013 69863	0.093151	0.09863
X_5	0.065753	0.071233	0.093151	0.046575		0.049315	0.071233	0.065753	0.043836	0.071233	0.0657 53425	0.09863	0.038356
X_6	0.087671	0.079452	0.071233	0.087671	0.093151		0.071233	0.046575	0.065753	0.043836	0.0712 32877	0.065753	0.087671
X_7	0.038356	0.10411	0.071233	0.093151	0.073973	0.043836		0.071233	0.10411	0.10411	0.0739 72603	0.071233	0.093151
X_8	0.043836	0.09589	0.038356	0.071233	0.065753	0.052055	0.076712		0.065753	0.043836	0.0657 53425	0.10411	0.093151
X_9	0.043836	0.087671	0.093151	0.071233	0.093151	0.076712	0.087671	0.090411		0.09863	0.0849 31507	0.079452	0.093151
X_{10}	0.035616	0.087671	0.065753	0.060274	0.043836	0.057534	0.09863	0.035616	0.093151		0.0630 13699	0.057534	0.068493
X_{11}	0.087671	0.065753	0.087671	0.09863	0.084932	0.087671	0.065753	0.090411	0.065753	0.060274		0.063014	0.093151
X_{12}	0.087671	0.049315	0.076712	0.046575	0.076712	0.063014	0.087671	0.049315	0.065753	0.090411	0.0575 34247		0.063014
X_{13}	0.10137	0.079452	0.087671	0.093151	0.09863	0.084932	0.076712	0.071233	0.060274	0.071233	0.0931 50685	0.071233	

Table 7: Matrix of Total Relationships

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	D
X_1	0.36 755	0.54 515	0.49 269	0.52 707	0.51 753	0.45 927	0.46 727	0.46 607	0.45 192	0.43 343	0.5001 06686	0.47 321	0.53 096	6.23 228
X_2	0.54 148	0.59 911	0.62 139	0.65 936	0.66 116	0.60 053	0.62 002	0.60 935	0.61 153	0.56 451	0.6609 69125	0.62 010	0.70 913	8.07 870
X_3	0.44 332	0.55 586	0.46 754	0.55 481	0.57 718	0.49 096	0.50 541	0.50 557	0.50 619	0.46 945	0.5376 85978	0.53 349	0.59 436	6.74 187
X_4	0.49 120	0.65 069	0.59 758	0.54 667	0.64 903	0.55 452	0.58 168	0.56 316	0.57 583	0.52 004	0.6330 06736	0.61 486	0.67 105	7.64 936
X_5	0.43 944	0.54 058	0.52 939	0.50 249	0.47 013	0.45 473	0.50 218	0.47 643	0.46 464	0.46 688	0.5126 70104	0.53 302	0.52 420	6.41 683
X_6	0.50 715	0.60 756	0.56 681	0.59 657	0.61 619	0.45 937	0.55 491	0.51 252	0.53 439	0.49 139	0.5758 15088	0.55 944	0.62 724	7.20 941
X_7	0.49 766	0.67 524	0.60 915	0.64 440	0.64 38	0.54 170	0.53 361	0.57 426	0.61 159	0.58 463	0.6226 23451	0.60 773	0.68 077	7.82 720
X_8	0.44 801	0.59 480	0.51 243	0.55 569	0.56 542	0.48 631	0.53 760	0.44 412	0.51 24	0.47 110	0.5458 12013	0.56 875	0.60 566	6.84 815
X_9	0.52	0.68	0.65	0.65	0.68	0.59	0.63	0.61	0.53	0.60	0.6563	0.64	0.70	8.19

	536	760	310	178	727	250	842	355	968	169	43185	029	763	527
X_{10}	0.41 760	0.56 331	0.51 309	0.52 287	0.52 108	0.46 918	0.53 330	0.45 767	0.51 583	0.40 808	0.5194 73096	0.50 309	0.55 979	6.50 441
X_{11}	0.54 035	0.63 905	0.61 976	0.64 729	0.65 131	0.57 642	0.58 948	0.58 743	0.57 233	0.54 017	0.5496 19291	0.59 782	0.67 645	7.78 751
X_{12}	0.47 407	0.54 305	0.53 450	0.52 243	0.56 118	0.48 348	0.53 486	0.47 892	0.50 134	0.50 102	0.5247 58002	0.46 032	0.56 523	6.68 522
X_{13}	0.56 829	0.67 053	0.63 895	0.66 182	0.68 223	0.59 123	0.61 720	0.58 830	0.58 562	0.56 715	0.6537 2002	0.62 264	0.61 092	8.05 865
R	6.26 156	7.87 256	7.35 645	7.59 330	7.80 355	6.76 025	7.21 601	6.87 741	6.98 332	6.61 960	7.4926 027775	7.33 481	8.06 345	

Finally, the cause and effect matrix of the indexes in question and also the plan of the relationships of cause and effect of the indexes respectively in the table 8 and the figure 1 have been illustrated.

Table 8: Cause and Effect Matrix

|	D	R	D-R	D+R
X_1	6.232285	6.26156	-0.029275	12.493845
X_2	8.078707	7.872566	0.206141	15.951273
X_3	6.741874	7.356451	-0.614577	14.098325
X_4	7.649368	7.593303	0.056065	15.242671
X_5	6.416836	7.803553	-1.386717	14.220389
X_6	7.209417	6.760253	0.449164	13.96967
X_7	7.827201	7.216016	0.611185	15.043217
X_8	6.848153	6.877418	-0.029265	13.725571
X_9	8.195275	6.983326	1.211949	15.178601
X_{10}	6.504411	6.619601	-0.11519	13.124012
X_{11}	7.787513	7.492602775	0.294910225	15.28011578
X_{12}	6.685221	7.334813	-0.649592	14.020034
X_{13}	8.058655	8.063453	-0.004798	16.122108
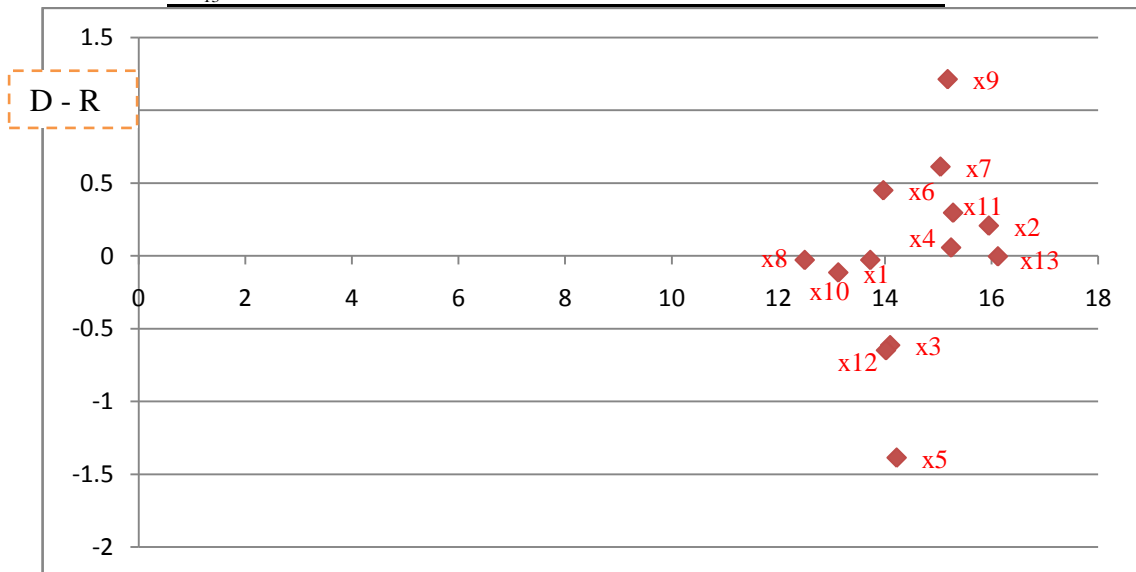
Figure 1 Relationship of Cause and Effect

Determining the weight of indexes through ANP: After drawing the plan of the relationship and categorizing the indexes into two active an passive groups (cause group) and passive group (effect group) and specifying the most effective and most passive indexes in the previous stage in this stage deals with the determination of the weight of each index through ANP method. The final table of the weight of each index in table 9 has been presented.

Table 9: final weight of indexes

X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
0.066	0.085	0.071	0.081	0.068	0.076	0.083	0.072	0.086	0.069	0.082	0.070	0.085
133	786	558	154	137	435	059	689	824	166	591	992	477

Final ranking of the indexes through VIKOR method
In this stage, from the matrix of interactive relationships obtained through DEMATEL method as the primary matrix and from the weights obtained through Analytic Network Process (ANP) as Wj required for VIKOR method we utilize.

The positive and negative ideal values of each index in table 9 have been shown:

Table 9- Positive and negative ideal matrix

	weight ANP	Positive Ideal	Negative Ideal
X_1	0.066133	0.56829836	0.36755575
X_2	0.085786	0.6876.434	0.54058028
X_3	0.071558	0.65310811	0.46754703
X_4	0.081154	0.66182082	0.50249708
X_5	0.068137	0.6872749	0.47013462
X_6	0.076435	0.60053733	0.45473029
X_7	0.083059	0.63841985	0.46727647
X_8	0.072689	0.613558	0.444123
X_9	0.086824	0.6115927	0.4519223
X_{10}	0.069166	0.601697	0.408081
X_{11}	0.082591	0.660969	0.500107
X_{12}	0.070992	0.640293	0.46032
X_{13}	0.085477	0.709137	0.524209

In this stage the R and S values have been obtained through desirability and undesirability matrix in the previous stage. The purpose of the R value for each index is the highest line value of each index and the purpose of the S value for each index is the collection of line values for each index. The calculations have been indicated in table 10.

Table 10- R and S values

	R	S
X_1	0.08682408	0.93117398
X_2	0.05163287	0.1141458
X_3	0.07686916	0.70999499
X_4	0.05864898	0.30287415
X_5	0.08578565	0.85860878
X_6	0.07399982	0.50837435
X_7	0.05086325	0.22024834
X_8	0.07268929	0.65756792
X_9	0.03910071	0.06563672
X_{10}	0.07264755	0.80286423
X_{11}	0.05716975	0.24903481
X_{12}	0.0843442	0.74441112
X_{13}	0.04539356	0.12554701
MAX	0.08682408	0.93117398
MIN	0.03910071	0.06563672

In this stage, the final values of Q for each index at three levels of confidence have been calculated and the final ranking of the indexes is performed. The calculations are shown in table 11.

Table11- values of Q and ranking of indexes.

|	V					
	0.00		0.50		1.00	
	Q	RANK	Q	RANK	Q	RANK
X_1	1.0000	13	1.0000	13	1.0000	13
X_2	0.2626	4	0.1593	3	0.0560	2
X_3	0.7914	10	0.7679	9	0.7445	9
X_4	0.4096	6	0.3419	6	0.2741	6
X_5	0.9782	12	0.9472	12	0.9162	12
X_6	0.7313	9	0.6214	7	0.5115	7
X_7	0.2465	3	0.2126	4	0.1786	4
X_8	0.7038	8	0.6939	8	0.6839	8
X_9	0.0000	1	0.0000	1	0.0000	1
X_{10}	0.7029	7	0.7774	10	0.8518	11
X_{11}	0.3786	5	0.2953	5	0.2119	5
X_{12}	0.9480	11	0.8661	11	0.7842	10
X_{13}	0.1319	2	0.1005	2	0.0692	3
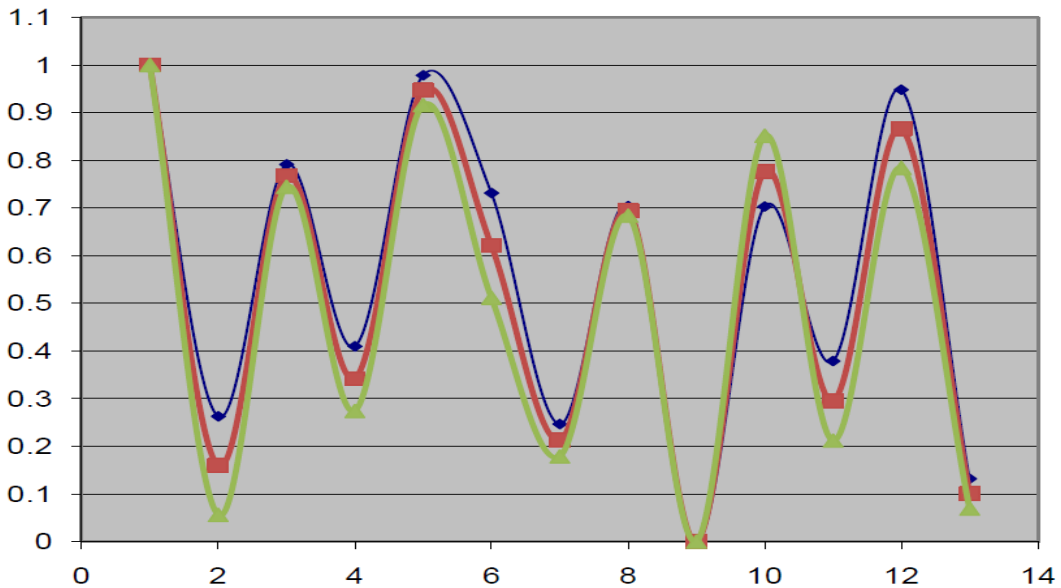
Figure 2- the diagrammatic condition of various states of ranking of the indexes with VIKOR method (Blue: v=0, Red: V=0.5, green: v=1).

5. Conclusion

The purpose of this study is to examine the entrepreneurial success index in the development of industrial plants active in Iranian industry. To do this, among the industries of Iran, Semnan industries have been considered as one of the most important industries in Iran in 2010. Also, to obtain more optimal results in this study, a combinative method was applied consisting of DEMATEL method, ANP and Vikor for the analysis of the ESI.

The results of using DEMATEL indicate that innovation, creativity and idealization are the most effective factor among the entrepreneurial success indexes in the development of industries and next high perseverance, confidence, being opportunistic, need for achievement, and tendency to risk taking were introduced as the most effective factors. In addition, concerning the effect group, the high tolerance of ambiguity is regarded as the most passive factor among the ESI in the development of industries and next being futuristic, possessing the internal focus of control, being realistic, being loyal to promise, being pragmatic, being idealist, being result oriented and being self dependent are introduced as the most passive factors, respectively.

Furthermore, the results obtained from ANP show that innovation, creativity and idealization are considered as the most important weight factors among the set of ESI factors effective on the development of industrial plants. And next in terms of weight importance is the need for achievement, being self dependent, high perseverance, being opportunistic, tendency to risk taking, confidence, being idealist, possessing the internal focus of control, being futuristic, high tolerance of ambiguity and being pragmatic, respectively.

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