The integrative approaches based on multi-criteria decision making models under uncertain condition for capital budgeting by considering the quality criteria: A case study in Industry and mine bank of Kurdestan province

Saghar Sarafi[1], Parviz Kafcheh[2], Hiwa Farughi[3]

[1]Executive Management Business Administration, Islamic Azad University of Sanandaj, Iran; [2]Department of Business Administration, University of Kurdistan, Iran; [3]Department of Industrial Engineering, University of Kurdistan, Iran

Abstract

This study presented an approach for selection, priority and budget assignment to industrial investment projects being based on group decision-making in multi-criteria decision making under uncertainty condition. In this approach, at first the indices and effective quality criteria on selection of industrial investment projects were identified via library studies and interview with the experts. Then, by fuzzy analytic hierarchy process and the comments of experts group, the relative importance of these criteria to each other was determined. To evaluate the existing alternatives as the available industrial projects for investment, fuzzy linear assignment was applied and finally the proposed approach was used in a case study in the industry and mine bank of Kurdistan province.

Keywords: Industrial investment projects, Fuzzy linear assignment, Multi-criteria decision making, Fuzzy analytic hierarchy process, Quality criteria.

Introduction

Decision making is the process of finding the best condition among the existing alternatives (Moheb. S., H. R. Maleki). Based on the complexity of the applied issues in the current world, dealing with decision making and the related details is unavoidable. The decision makers in multi-criteria decision making issues require the selection and ranking of the alternatives with opposite and non-objective features. This is occurred in the real world as in financial and capital budgeting issues. Generally, there are various criteria in the evaluation of investment projects being important in selection of the final portfolio. Among the researches done in prioritization and selection of industrial investment projects, the studies of Maillie and park (1970) can be referred. They divided the evaluation indicators into four categories: production, company capacity, environmental factors and alternative competition (Park, W. R., J. B. Maillie, 1970). Kelly et al. (1971) considered some indicators that are technology, professionals, production, market and investment (Kelley, A. J., F. B. Campanella, J. McKiernan, 1971). Chotigeat et al. (1997) considered investors risk, market demand, management team, market growth potential and investment liquidity (Kelley, A. J., F. B. Campanella, J. McKiernan, 1971). Tang and Wang (1999) applied degree of product differentiation, market attractiveness, management capacity, economic efficiency, and environmental impact as effective factors (Tang, J. H., Y. Z. Wang, 1999). Han and Ma (2001) constructed six indicators: technical risk, production risk, market risk, operational risk, financial risk and environmental risk (Han, J. X., L. Ma, 2001). Liu et al. (2010) considered effective factors in six groups of financial risk, technology risk, production risk, market risk, management risk and environmental risk (Liu, Peide, Zhang, Xin, Liu, Weilong, 2010). Kakati (2003) in his study considered success criteria in high-tech new ventures by the entrepreneur quality,resource-based capability, competitive strategy, product characteristics, mar-

Corresponding author: Saghar Sarafi, Executive Management Business Administration, Islamic Azad University of Sanandaj, Iran. E-mail: saghar.sarafi@gmail.com

ket characteristics, financial criteria (Kakati, M., 2003). Mehdi Bigdelo and Amir Mostavafi (2004) in a study proposed risk evaluation multi-criteria model in new venture investment companies. The risks of new ventures were identified in nine groups of entrepreneur risk, product risk, technology risk, market risk, financial risk, operational /executional risk, organizational risk, strategy risk and environmental risk (Bigdeloo. M, A. Mostafavi, 2004). Tiryaki et al. (2009) by considering the uncertainty conditions, applied fuzzy analytic hierarchy process in selection of investment portfolio (Tiryaki, Fatma, Ahlatcioglu, Beyza, 2009). Ozkir and Demirel (2012) considered the selection of the best investment project in Transportation

Investment project (TIP) by considering the economic, social and environmental criteria at the same time and by Multi Criteria Decision making Methods (MCDM) proposed a fuzzy evaluation method to help the selection of a multi-criteria project by entropy and interval normalization approach in fuzzy analytic hierarchy process (F-AHP) and applied fuzzy linear planning model to select the best TIP portfolio by considering the uncertain costs (Ozkir, Vildan, T. Demirel, 2008). Jun ye (2010) presented a multi-criteria fuzzy decision making method in accordance with weight correlation coefficients based on entropy weights in fuzzy environment for decision making process (Ye, Jun,2010). Mohebi and Maleki (2011) presented a method to solve the group decision making issues in fuzzy environment based on entropy technique combination (to determine the weight of indicators) and Cao et al. algorithm. The relative importance of each index, its priority degree of the index to the other indices are evaluated for decision making. Generally, based on any selective alternative, an index called closeness coefficient is determined and all the alternatives are ranked by it (Mohebi S., H. R. Maleki). Mohammadi and Iranmanesh (2009) stated that as there are various criteria such as financial, technical, management, environmental and organizational factors in selection of organizational project portfolio, it is better to use FAHP as new instrument in ranking the organization projects. Finally, by the proposed approach in Iran building holding complex working in housing and building industry, the project portfolio is selected (Mohamdi Bolbanabad. Iranmanesh, S,M. 2009). KhaliliAraqi (2008) applied group multi-criteria planning models in capital budgeting in which the quality and quantity indices are considered in investment projects and by group agreement by ranking the projects, the priority is considered. The main indices were extracted based on the experts' judgment and they were classified in financial and risk indices. To do this, brain storming combinational method and voting were applied and the indices weights were determined by Borda count. For projects prioritization, TOPSIS method was applied (Kalili Araghi. M, 2008).

Generally, investment is identified as an orientation in creating future net profit. The results of future decisions are not predicted completely and they are uncertain. Risk is due to the uncertainty in project variables. If the investment risk is considerable, the risk extra costs for the unpredicted events increase the costs of each investment organization and decrease profit. If the loss of unpredicted events is considerable, the profit will be negative and the investor goes bankrupt (Askari. M, 2004). As all the effective criteria in investment decision making are uncertain and create some complexities in decision making process and under uncertainty conditions, a person by available information cannot describe the behavior and features of a system as exactly and the probabilities of the events are not determined, based on the lack of information and statistics in events occurrence frequency and the lack of computation of probability distribution function, by fuzzy logic, the existing uncertainties are formularized (Ghasemi. A, S. Mahmoodzade, 2010.

The proposed integrative approach

The proposed approach in this study is two – stage. The first section deals with the identification and selection of the effective quality criteria in industrial investment decisions and determining the importance degree (weight) of each of them and the second section deals with the evaluation and ranking of the available alternatives for industrial investment.

The selection of the criteria and determining the importance degree (weight) of each of them in industrial investment projects

In this stage, the effective quality criteria are selected by review of literature and using the experts' comments in industry and industry and mine bank in a process similar to Delphi method and finally they were selected. Table (1) shows the main criteria and effective sub-criteria in industrial investment decisions. After determining the effective criteria in industrial investment decisions and the related sub-criteria, the weight and importance degree of each of them should be calculated. Based on the variety of the existing criteria and the existing complexity in decision making, multi-criteria decision making methods can be applied. In order to determine the required weights, fuzzy AHP was applied. As estimating the attributes of some phenomena is difficult numerically, verbal variables are used and their numerical equivalence are presented in triangular fuzzy number in Table 2. In other words, using fuzzy logic is in conformity with subjective and empirical judgments of experts and fuzzy AHP is applied. It can be said that collecting the comments of the experts was done by researcher-built questionnaire. The questionnaire in this study is consisting of 7 paired-comparison matrices. These matrices were formed to compare 6 main criteria with each other (first level criteria-comparison based on aim), then to compare the sub-criteria of each main criteria (comparison based on each main criteria).

Table 1.The effective criteria and the related sub-criteria in industrial investment decisions

entrepreneur characteristics	product characteristics	environmental characteristics	technological characteristics	market characteristics	financial criteria
Ability to articulate in the discussion	Life cycle of product	The favorable degree of the social environment	Availability of higher technology	Market enjoying significant growth rate	Investment could be made easily liquid
Desire for success	Uniqueness of product/services		Life cycle of technology	logic of distribution channel	Return on investment
Attention to detail	relative to competitors	The favorable degree of the economic environment	Organizational capability to conformity	Marketing ability	Financing ability
Enthusiasm /capacity for work	Protection of the product			Conformity with market dynamism	The supply ability of the production capital
Capability in the field of endeavor	Product enjoyed market acceptance	The favorable degree of the policy and legal environment	Source of technology and goodwill of manufacture	Investment motivation in exist market	The changeable degree of interest rate
Ability to evaluate and react to risk well				Competitive product	
Experience about market/technology			The hard-easy degree of technical loss	The effect of potential competitors	The changeable degree of exchange rate
Creativity			The standardization degree of the production equipment and		
Familiarity with the target market			Process		
			The substitutability of the technology		

Table 2. Verbal variables for determining the importance degree of criteria in selecting investment project

verbal variables	Abbreviations	Triangular fuzzy numbers
Very important	VI	(0.9,1,1)
Important	I	(0.9,0.7,1)
Approximately important	AI	(0.5,0.7,0.9)
Medium	M	(0.3,0.5,0.7)
Approximately unimportant	AU	(0.1,0.3,0.5)
Unimportant	U	(0.05,0.1,0.3)
Very unimportant	VU	(0.01,0.05,0.1)

Reference: (Khorshid. S, 2010)

Fuzzy AHP

Hierarchy analysis process provides a framework for group collaboration in decisions or solving the problems. In addition, the need to paired comparison in this method is one of its advantages as the decision maker is required to think more about the factors weights and analyze the situation as deeply (Mohamdi Bolbanabad. Iranmanesh, S,M. 2009. There are various approaches for fuzzy AHP. In this study, Changextent analysis method is applied. Fuzzy numbers in this method are triangular fuzzy numbers (Alamtabriz. A, M.R. Menbari, 2011). Now the fuzzy AHP is explained from Chang view. The steps of this process are as following:

First step: For each of the matrix rows of paired comparisons, S_k value that is a triangular fuzzy number is calculated, this value is computed as equation (1):

$$S_k = \sum_{j=1}^{n} M_{kj} \times \left[\sum_{i=1}^{m} \sum_{j=1}^{n} M_{ij}\right]^{-1} \quad (1)$$

K denotes row number and i,j show the alternatives and indices. After the calculation of S_k, their magnitude degree to each other is achieved. Generally,

$$\begin{cases} V(M_1 \geq M_2) = 1 & M_1 \geq M_2 \\ V(M_1 \geq M_2) = hgt(M_1 \cap M_2) & o.w \end{cases} \quad (2)$$

$$hgt(M_1 \cap M_2) = \frac{u_1 - L_2}{(u_1 - L_2) + (m_2 + m_1)} \quad (3)$$

The magnitude of a triangular fuzzy number of other k triangular fuzzy numbers is obtained of equation (4):

$V(M_1 \geq M_2,...,M_k) = V(M_1 \geq M_2)$ and ... and $V(M_1 \geq M_k)$ (4)

To compute the indices weight in paired comparisons matrix, equation (5) is as (Azar. A, H. Faraji, 2008):

$$w(x_i) = \min\{V(S_i \geq S_K)\} K=1,2,...,n \quad k \neq i \quad (5)$$

Determining the available relative weights for investment

After determining the criteria and related sub-criteria importance degree, the relative weights of industrial investment alternatives is determined in relation with the criteria and determining their final weights. Again, the expert team with comprehensive information about investment alternatives is asked to determine the condition of each of the alternatives in relation with each of the criteria and sub-criteria by the existing verbal variables in Table 3. To do this, fuzzy linear assignment is used. It can be said that in this stage, to collect the experts' comments, the uniform average is applied. In methodology of fuzzy linear assignment, the alternatives are ordered based on standard linear planning model. In this method, the interaction with the decision maker is as paired comparison of the alternatives (paired-comparison). Indeed, this methodology based on the introduced preferences of the decision makers for the alternatives, based on the problem limitations, is sorted. In fuzzy linear assignment method, first the fuzzy equivalence of verbal variable dedicated to jth project to cth criteria by decision maker ith denoted by is obtained and then by the following equations, the final weights of the investment alternatives are calculated.

Table 3 . Verbal variables for evaluating available investment project

verbal variables	Abbreviations	Triangular fuzzy numbers
Very important	VI	(0.9,1,1)
Important	I	(0.9,0.7,1)
Approximately important	AI	(0.5,0.7,0.9)
Medium	M	(0.3,0.5,0.7)
Approximately unimportant	AU	(0.1,0.3,0.5)
Unimportant	U	(0.05,0.1,0.3)
Very unimportant	VU	(0.01,0.05,0.1)

Reference: (Khorshid. S, 2010)

$$\widetilde{A_{ijc}} = (a_{ijc}, b_{ijc}, c_{ijc}) \quad (6)$$

I=1,2,...,N
j=1,2,...,K
c=1,2,...,c

$$\widetilde{A_{jc}} = \frac{1}{N} \times \left(\widetilde{A_{1jc}} + \widetilde{A_{2jc}} + \cdots + \widetilde{A_{Njc}}\right) = (a_{jc}, b \quad (7)$$

The obtained score is fuzzy number being computed based on averaging the decision makers' comments and finally by center of gravity method, it is defuzzificated and is changed into crisp value.

$$A_{jc} = \frac{(a_{jc} + b_{jc} + c_{jc})}{3} \quad (8)$$

To calculate the importance degree of each investment project, the following formula is used:

Weight (importance degree) of project j in criteria cth: W_{jc}

$$W_{jc} = W_c \times A_{jc} \quad (9)$$

$$W_j = \sum_{c=1}^{C} W_{jc} \quad (10)$$

Indeed, the importance degree of each project is the sum of multiplication of the importance of criteria by alternatives weight. To make the obtained weights scale less, normalization was applied by equation (11).

The sum of the final normal weights of jth projects: W_{Aj}

$$W_{Aj} = [(\sum_{c=1}^{C} W_{jc}) / \sum_{j=1}^{K} \sum_{c=1}^{C} W_{jc}] \quad (11)$$

Thus, the weight of each of the investment projects is determined and ranking among the alternatives is done and the most prioritized designs for investment are selected.

Case study

In order to show the application of the proposed approach for analysis and prioritization of investment projects, the following example was used: Industry and mine bank, 14 investment projects for prioritization and selection of the best projects to allocate budget to them being presented to determine the importance degree and their ranking of the approach were applied in the present study. As it was said, the main criteria identified for the selection and evaluation of the industrial investment projects were 6 criteria with sub-criteria in Table 1 that are explained in details.

As it was said in the model description, to determine the importance coefficient of the main criteria and sub-criteria, paired comparison matrix was applied and in accordance with the available experts, 7 people of them had corresponding paired comparison with compatibility rate less than 0.1 and based on group AHP method and fuzzy AHP, the main matrices of group paired comparison were computed. The main matrices of the paired comparison were the result of the collection of the experts' comments by geometry mean method in each of the required criteria. Table 4 is one of the final tables of paired comparison being presented as an example.

Table 4. Final pair comparing matrix of 6 main criteria

TDM	C1	C2	C3	C4	C5	C6
C1	(1.00, 1.00, 1.00)	(0.66, 0.85, 0.97)	(0.46, 0.69, 0.87)	(0.58, 0.77, 0.91)	(0.55, 0.75, 0.93)	(0.49, 0.69, 0.88)
C2	(1.03, 1.18, 1.52)	(1.00, 1.00, 1.00)	(0.56, 0.75, 0.91)	(0.64, 0.84, 0.97)	(0.47, 0.67, 0.85)	(0.44, 0.64, 0.82)
C3	(1.16, 1.45, 2.18)	(1.10, 1.33, 1.80)	(1.00, 1.00, 1.00)	(0.56, 0.77, 0.92)	(0.42, 0.63, 0.82)	(0.48, 0.69, 0.85)
C4	(1.10, 1.31, 1.73)	(1.03, 1.19, 1.57)	(1.08, 1.30, 1.78)	(1.00, 1.00, 1.00)	(0.41, 0.62, 0.80)	(0.54, 0.75, 0.89)
C5	(1.08, 1.33, 1.82)	(1.18, 1.49, 2.13)	(1.22, 1.59, 2.37)	(1.24, 1.61, 2.43)	(1.00, 1.00, 1.00)	(0.61, 0.79, 0.92)
C6	(1.13, 1.45, 2.05)	(1.22, 1.57, 2.29)	(1.18, 1.46, 2.08)	(1.12, 1.34, 1.84)	(1.08, 1.26, 1.65)	(1.00, 1.00, 1.00)

Sk	Sk	S1	S2	S3	S4	S5	S6	W't	W		
(0.07690, 0.12586, 0.18017)	S1		0.9172	0.7388	0.663	0.3802	0.3188	0.31878	0.078831		
(0.08507, 0.13445, 0.19682)	S2	1		0.8277	0.7579	0.4777	0.4213	0.421283	0.104179		
(0.0972, 0.15518, 0.24539)	S3	1	1		0.9447	0.6887	0.6442	0.644242	0.159314		
(0.1065, 0.16331, 0.25223)	S4	1	1	1		0.7353	0.691	0.691025	0.170883		
(0.13025, 0.20722, 0.34623)	S5	1	1	1	1		0.9685	0.968516	0.239504	CI	CR
(0.13894, 0.21396, 0.35405)	S6	1	1	1	1	1		1	0.247289	0.096291	0.077654

Finally, based on the calculations, the weight of all criteria and sub-criteria with desirable compatibility rate (less than 0.1) was obtained as shown in Table (5). The values in table showed that among the effective quality criteria on investment decisions, financial criteria with importance coefficient

0.2473 had the highest importance and the major effect in industrial investment. After financial criteria, the market characteristics with importance coefficient 0.2395 and then other criteria, technological characteristics with importance coefficient 0.1709, environmental characteristics with importance coefficient 0.1593, productcharacteristics with importance coefficient 0.1042 and finally entrepreneur characteristics with importance coefficient 0.0788, respectively are considered.

Table 5. Importance degree (weight) of each effective criteria and sub-criteria in industrial investment decisions

Number	description	Weights of criteria	Consistency ratio of pair compare matrices
1	entrepreneur characteristics	0.078831	
1-1	Ability to articulate in the discussion	0.051034	0.07932
1-2	Desire for success	0.052408	
1-3	Attention to detail	0.081827	
1-4	Enthusiasm /capacity for work	0.105054	
1-5	Capability in the field of endeavor	0.125725	
1-6	Ability to evaluate and react to risk well	0.145521	
1-7	Experience about market/technology	0.102966	
1-8	Creativity	0.151885	
1-9	Familiarity with the target market	0.18358	
2	product characteristics	0.104179	
2-1	Life cycle of product	0.148916	0.06846
2-2	Uniqueness of product/services relative to competitors	0.241622	
2-3	Protection of the product	0.28296	
2-4	Product enjoyed market acceptance	0.326502	
3	environmental characteristics	0.159314	
3-1	The favorable degree of the social environment	0.255582	0.05279
3-2	The favorable degree of the economic environment	0.358628	
3-3	The favorable degree of the policy and legal environment	0.38579	
4	technological characteristics	0.170883	
4-1	Availability of higher technology	0.07251	0.07176
4-2	Life cycle of technology	0.07954	
4-3	Organizational capability to conformity	0.11207	
4-4	Source of technology and goodwill of manufacture	0.15918	
4-5	The hard-easy degree of technical loss	0.17949	
4-6	The standardization degree of the production equipment and Process	0.20211	
4-7	The substitutability of the technology	0.19511	
5	market characteristics	0.239504	
5-1	Market enjoying significant growth rate	0.071056	0.074035
5-2	logic of distribution channel	0.098704	
5-3	Marketing ability	0.106175	
5-4	Conformity with market dynamism	0.106399	
5-5	Investment motivation in exist market	0.195514	
5-6	Competitive product	0.20484	
6	financial characteristics	0.247289	
6-1	Investment could be made easily liquid	0.06414	0.087709
6-2	Return on investment	0.12504	
6-3	Financing ability	0.18785	
6-4	The supply ability of the production capital	0.17926	
6-5	The changeable degree of interest rate	0.20888	
6-6	The changeable degree of exchange rate	0.23483	

Determining the final weights of industrial investment alternatives

After determining the criteria and sub-criteria importance degree, the relative weights of the alternatives is determined compared to the criteria and their final weights are obtained. To do this, an expert team consisting of 3 people of industry and mine bank authorities of Kurdistan province with comprehensive information about the alternatives were asked to determine the condition of each of the alternatives in relation with each of the criteria and sub-criteria. Based on the stages in fuzzy assignment method, the relative weight of each alternative in relation to each criterion was computed and finally the final weight of each alternative (project) was calculated via equation (10). The required calculations to determine the final weight of the projects and fourteen alternatives were done based on the mentioned methods and the sorted results of the final weight of the alternatives are shown in Table (6).

Table 6. Ranking of the available alternatives for industrial investment project

Weights (importance degree)		Project
0.091796	A8	Cement flooring - Mosaic and pre-built components and lightweight concrete and cement
0.089059	A6	Various types of artificial leather
0.082715	A9	Manufacture of metal moulds and electroplating on metals and other industrial operations
0.082452	A10	Various types of Sheets and parts of injected plastic
0.07504	A11	Fruit grading and packing
0.074544	A1	Oxygen production
0.074141	A12	Upvc doors and windows and double glasses
0.072272	A7	pasteurized milk and other dairy products
0.070153	A2	Polyethylene pipes
0.066868	A4	Polystyrene anti-fire foam
0.058053	A13	Ready Concrete
0.055993	A3	Disposable plastic containers1
0.055632	A5	Various types of cardboard Boxes
0.051282	A14	Disposable plastic containers2

Conclusions

Based on the existing limitations in the resources, their optimized allocation to achieve the optimum values of investors is of the great requirements of decision making. Based on this issue, the main purpose of the study is prioritization of the industrial investment alternatives under uncertainty conditions. This prioritization determines the preferences of the investors or decision makers in allocation of financial and monetary resources to available investment alternatives and provided group decision making by applying geometry mean to collect all comments of decision makers. In multi-criteria decision making models, there are various crisp and fuzzy ranking methods making the ranking of the studied alternatives to decision makers possible. In financial applications, the decision maker or investor besides being interested in the ranks of alternatives tries to know the proportion of each of them in available investment. The model applied in this study, provided the weight and rank information of the alternatives by AHP method and linear assignment method in fuzzy space for the investors. To show the practical use of the proposed conceptual model in this paper, one practical example about decision making on 14 industrial investment projects in industry and mine bank of Kurdistan province was considered and by identification of the main effective criteria on evaluation and prioritization of the investment projects, these criteria were classified into 6 groups and besides determining the sub-criteria of each level, the weight or importance degree of them were computed based on the experts' comments in fuzzy AHP method. By determining the condition of each of the industrial investment projects in relation to 6 criteria and their sub-criteria, these projects were prioritized and weighted by the calculations in fuzzy linear allocation model.

References

Alam Tabriz. A,Menbari, M.R., (2011). Using value engineering by fuzzy MADM approach for optimizing the project performance, *Journal Of Industrial Management, Tehran University, 3*(6), p. 81-98

Askari. M. (2004). Risk analysis of investment evaluating, In the Proceedings of the 2004 new venture investment conference

Azar. A, &Faraji.H. (2008). Fuzzy management science, Tehran, Ketabemehraban publisher

Bigdeloo.M,A., & Mostafavi (2004). Multi criteria model to evaluating the risk of new venture investments, In the Proceedings of the 2004 new venture investment conference, 1-5

Ghasemi. A, &Mahmoodzade, S. (2010). Evaluating economic projects in uncertain environment, *Journal Of Economic Researchs, 93*, p 83-108

Han, J.X., & L. Ma (2001). Analysis and measurement of venture of investment into high technology projects, J. Harbin Inst. Technol. 3, 300–303.

Kakati, M. (2003). Success criteria in high-tech new ventures, Technovation 23, 447–457

KaliliAraghi .M. (2008). Capital budgeting: group multi criteria, economic bulletin

Kelley, A.J., Campanella, F.B., & McKiernan, J. (1971). Venture capital: a guidebook for new enterprises mass, school of management, Boston College, 33–34

Khorshid. S. (2010). Evaluating and ranking agile production capacity in Khuzestan steel industry by fuzzy entropy hierarchy process, *Journal Of Industrial Management, Sanandaj Azad university, 5*(11), p 1-19

Liu, Peide, Zhang, Xin, Liu, Weilong (2010). A risk evaluation method for the high-tech project investment based on uncertain linguistic variables, *Technological Forecasting and Social Change*, 1-11

MohamdiBolbanabad. S., & Iranmanesh, M. (2009), Fuzzy portfolio selection and management using fuzzy analytic hierarchy process; case study: Iran building holding complex, *Journal Of Industrial Management, Sanandaj Azad university, 4*(7)

Mohebi. S, & Maleki. H.R. (2011) Preparing a method for group decision making in fuzzy environment, In the Proceedings of the 2011 fuzzy systems conference in Iran

Ozkir, Vildan, Demirel, T. (2008), A fuzzy assessment framework to select among transportation investment projects in Turkey, *Expert Systems with Applications 39* , 74–80

Park, W.R., & Maillie, J.B. (1970), Strategy analysis for venture evaluation, *J. Bus. Venturing* 207–214

Tang, J.H., & Wang, Y.Z. (1999). Research on risk investment indices system, J. Beijing Polytechnic Univ, 25 (6), 42–44.

Tiryaki, Fatma, Ahlatcioglu, Beyza (2009). Fuzzy portfolio selection using fuzzy analytic hierarchy process, *Information Sciences, 179*, 53–69

Ye, Jun, (2010). Fuzzy decision-making method based on the weighted correlation coefficient under intuitionistic fuzzy environment, *European Journal of Operational Research, 205*, 202–204