

Using Vikor Technique for Evaluating Customer Satisfaction in Bank Using Entropy Weight

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ABSTRACT: There are many techniques of Multi-Criteria Decision Making MCDM methods that are able to rank alternatives in decision problems with conflicting criteria. This paper provides a comprehensive survey of Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) and its family for MCDM problems. Vlse Kriterijska Optimizacija Kompromisno Resenje(VIKOR), and Distance to the ideal Alternative DIA methods, which has already become a quite popular multi-criteria decision-making MCDM tools. Two methods TOPSIS and VIKOR seem to be more appropriate for solving the retrofit selection problem because of their capability to deal with each kind of judgment criteria, the clarity of their results, and the reduced difficulty to deal with parameters and choices they involve. This paper provides a comparison analysis of the above-three methods. To avoid the limitation of TOPSIS, DIA calculates the Manhattan distance to select the best interface while ensuring no ranking abnormality problem and provide a good accuracy in identifying the alternative ranks.

KEYWORDS: Multi-attributes Decision Making, VIKOR, TOPSIS, SAW, Fuzzy AHP, decision-making, quantitative methods, weights of criteria, Pairwise Comparison, DIA.

I. INTRODUCTION

Making a decision implies that there are alternative choices to be considered, and in such a case we want not only to identify as many of these alternatives as possible but to choose the one that best fits with our goals, objectives, desires, values, and so on.

Three kinds of formal analysis can be employed to solve decision-making problems:

1. Descriptive analysis is concerned with the problems that decision makers (DM) actually solve.
2. Prescriptive analysis considers the methods that DM ought to use to improve their decisions.
3. Normative analysis focuses on the problems that DM should ideally address.

The main difficulty in MCDM problems lies in the fact that usually there is no objective or optimal solution for all the criteria. Thus, some trade-off must be done among the different points of view to determine an acceptable solution. Therefore, it is not easy problem at all, which explains the large amount of publications in the area in the last decades. Although MCDM problems have been studied in the operational research area for a long time, recently there is an increasing interest in including Artificial Intelligence techniques to the classical numerical methods.

Other approaches let the user to provide heterogeneous data, which is automatically translated into a unified scale before their processing. In this case, the transformation obtained does not contain all the information that the person has initially provider. For this reason, sometimes it is argued that is better to allow only a unique scale for providing the data. The main motives of this paper the extensive uses of banking operations for peoples and organizations.

II. LITERATURE REVIEW

A.A. Rassafi and M. Vaziri [¹], characterize national transportation modes to assess balancing and sustainability. Using a pioneer measure for sustainable development (SD), and based on the conformity of the growths of all sectors with

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

transportation modes, the countries are comparatively studied. The proposed measure, elasticity, for each pair of variables indicates the extent to which the two variables have been changing consistently. Having developed the elasticity of the social, environmental and economic variables with respect to those of modal transportation, composite modal sustainability indices were suggested. The composite indices were then integrated into a unique SD index utilizing the Data Envelopment Analysis (DEA), and Concordance Analysis (CA) techniques. For comparative appraisal, country ranking and grouping based on DEA scores, as well as CA results were developed. The sustainability appraisal showed interesting patterns within and between group similarities and differences. The study confirmed the significance of modal transportation balancing and sustainability challenges of the 21st century. The research focus is on its methodology. Thus, the data gathered from any other time period and geographical scope may be used for further analysis.

Mei-Tai Chu, et al. [2], Knowledge management can greatly facilitate an organization's learning via strategic insight. Assessing the achievements of knowledge communities (KC) includes both a theoretical basis and practical aspect; however, a cautionary word is in order, because using improper measurements will increase complexity and reduce applicability. Our results showed that TOPSIS and simple average weight (SAW) had identical rankings overall, but TOPSIS had better distinguishing capability. TOPSIS and VIKOR had almost the same success setting priorities by weight. However, VIKOR produced different rankings than those from TOPSIS and SAW, and VIKOR also made it easy to choose appropriate strategies. Both the TOPSIS and VIKOR methods are suitable for assessing similar problems, provide excellent results close to reality, and grant superior analysis.

N. Caterino, et al. [3], defined that the selection of a strategy to seismically upgrade an existing building is a difficult problem. In fact, several different technologies are available to this aim nowadays. Furthermore, many generally conflicting options have to be considered to assess the performance of each alternative. This article uses two methods TOPSIS and VIKOR among those considered, seem to be more appropriate for solving the retrofit selection problem because of their capability to deal with each kind of judgment criteria, the clarity of their results, and the reduced difficulty to deal with parameters and choices they involve.

Vijay M. A., Prasenjit C., and Shankar C. [4], illustrates the selection of an industrial robot for a specific engineering application is one of the most challenging problems in real time manufacturing environment. This has become more and more complicated due to increasing complexity, advanced features and facilities that are continuously being incorporated into the robots by different manufacturers. The decision maker needs to select the most suitable industrial robot in order to achieve the desired output with minimum cost and specific application ability. This paper mainly focuses on solving the robot selection problem using VIKOR (Vise Kriterijumska Optimizacija Kompromisno Resenje) method, which has already become a quite popular multi-criteria decision-making (MCDM) tool. One real time example is cited in order to demonstrate and validate the effectiveness and applicability of VIKOR method.

Nihan C. D., and G.Nilay Y. [5], In this paper a decision making problem is considered and fuzzy analytic network process (ANP) and extended fuzzy VIKOR methodologies have been proposed to deal with the cruise port place selection problem in Istanbul. They proposed a model for selection of the most suitable place by using analytical network process and VIKOR method under fuzzy environment due to linguistic terms and compares the fuzzy analytic network process and VIKOR method results.

S.A. Nabavi Chashmi et al. [6], evaluates and ranks the performance of Mellat Bank branches under the supervision of Sari area based on financial challenges after privatization using AHP FUZZY & TOPSIS techniques. The study result indicated that concerning the calculated final weights, the indices of active issued cards number (withdrawal & credit), the percentage of cash machine (A.T.M) functioning time and the percentage growth and balance of the other Rial

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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Vol. 6, Issue 5, May 2017

resources have stood first to third in priority and in ranking of this town branches, in addition to considering all financial challenges and indices related to Farhang, Enghelab and Khadamate Darmani in Sari have stood first to third.

Dr.A.K.Shaik Dawood et al.[⁷] Multi-Criteria decision making (MCDM) techniques are appropriate tools to prioritize under sophisticated environment, and are able to rank alternatives in decision problems with conflicting criteria. Banks represent entities of the financial market and the overall system for financing of the economy. This paper was performed a ranking of the banks through the application of the TOPSIS method With Entropy Weight.

Dr Elsyed et al[⁸] The purpose of this paper is to apply a Fuzzy Analytical Hierarchy Process model FAHP for estimating students' importance indexes problem, where the measures of students' attitudes and responses are often uncertain or difficult to determine by using non-fuzzy model. This paper introduces fuzzy theory with AHP approach to the research of university services as customers in public firms and it has reached some valuable conclusions.

Ali Mohaghar , et al. [⁹], the objective of this paper is to present a new methodology for selecting of marketing strategy by integration of Linear Goal Programming model and Fuzzy VIKOR. LGP method is used to determine the fuzzy weights of criteria and Fuzzy VIKOR aims to rank strategies. They applied the integrated approach in real case to demonstrate the application of the proposed method.

III.PROBLEM DESCRIPTION

A problem of finding the bank at a known place solved by ranking the different Banks due to some effective criteria, The criteria considered as the different ways of evaluating, reflecting specific needs of the decision maker may be of both economical/social and technical types.

Table 1 List of Banks

B_i	Name
B₁	The National Commercial Bank (NCB)
B₂	Bank Al-bilad
B₃	Riyad Bank
B₄	Arab National Bank (ANB)
B₅	Bank Al-jazira
B₆	The Saudi Investment Bank
B₇	Al Rajhi Bank
B₈	Al-inma Bank
B₉	Saudi French Bank
B₁₀	Saudi British Bank (SABB)
B₁₁	Saudi Hollandi Bank
B₁₂	Saudi American Bank (SAMBA)

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Table .2: list the Main Criteria Collected for the Different Banks.

Symbols	Description
C ₁	The growth rate of net income
C ₂	Bank's capital
C ₃	Investment in employees development
C ₄	Number of bank branches in Saudi
C ₅	Number of bank ATMs
C ₆	points of sale
C ₇	Number of bank employees
C ₈	The percentage of Saudis employed
C ₉	The percentage of foreign employed
C ₁₀	Awards achieved by the Bank
C ₁₁	Customer deposits
C ₁₂	Percentage increase in customer deposits
C ₁₃	Total assets
C ₁₄	Shareholders' equity
C ₁₅	Percentage increase in shareholders' equity
C ₁₆	net income
C ₁₇	Earnings per stock
C ₁₈	Average number of stocks
C ₁₉	Foreign exchange income
C ₂₀	Investment Income
C ₂₁	Net special commission income
C ₂₂	Total operating income
C ₂₃	Lending and advances
C ₂₄	Percentage increase in Lending and advances
C ₂₅	Capital adequacy ratio of central

IV. TOPSIS METHOD

As stated above, the TOPSIS (technique for order preference by similarity to ideal solution; according to the method, first all the a_{ij} values in the decision matrix. Table 3 illustrates the decision matrix contain the main effective criteria of the different Banks under study. The compromise solution can be regarded as choosing the solution with the shortest Euclidean distance from the ideal solution and the farthest Euclidean distance from the negative ideal solution. Next the positive ideal point (PIS) and the negative ideal point (NIS) are derived as:

$$\begin{aligned}
 PIS &= A^+ = \{v_1^+(x), v_2^+(x), \dots, v_j^+(x), \dots, v_m^+(x)\} \\
 &= \{(max_k v_{kj}(x) | j \in J_1), (min_k v_{kj}(x) | j \in J_2) | k = 1, \dots, n\} \\
 NIS &= A^- = \{v_1^-(x), v_2^-(x), \dots, v_j^-(x), \dots, v_m^-(x)\} \\
 &= \{(min_k v_{kj}(x) | j \in J_1), (max_k v_{kj}(x) | j \in J_2) | k = 1, \dots, n\},
 \end{aligned}$$

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Table 3. The Decision Matrix

	C1	C2	C4	C5	C11	C13	C14	C16	C22	C23
B1	7	15 B	312	1,891	274 B	345,300 M	39,400 M	6,613 M	12,138 M	163 M
B2	72	3 B	88	728	23,742M	29,778 M	4,371 M	941,804 M	1,758 M	1,078 M
B3	10	15B	252	2,594	146,215M	190,181 M	31,963 M	3,466 M	6,865 M	117,471 M
B4	10	8 B	145	980	107,560M	136,639 M	17,804 M	2,371 M	4,784 M	86,329 M
B5	65	3B	54	350	40,675 M	50,957 M	5,012 M	501 M	1,600 M	29,897 M
B6	29	5 B	48	380	40,414 M	59,067 M	9,378 M	912 M	1,868 M	34,051 M
B7	7	15B	476	3,300	221,342M	267,382 M	36,468 M	78,470 M	14,328 M	2,212 M
B8	70	15B	87	650	32,214 M	54,014 M	16,664 M	733 M	1,826 M	819 B
B9	4	9 B	86	591	115,571M	157,777 M	22,686 M	3,015 M	5,011 M	103 M
B10	12	10 B	79	579	120,433M	156,652 M	20,065M	3,240 M	5,166 M	96,098 M
B11	21	3 B	45	261	53,913 M	68,505 M	8,305 M	1,253 M	2,219 M	453 M
B12	1	9 B	72	530	148,736M	199,224 M	31,636 M	4,333 M	6,694 M	104,800 T

Table 4 : Weighted Normalized Matrix and Two Artificial Extreme

	C1	C2	C4	C5	C11	C13	C14	C16	C22	C23
B1	0.004301	0.065226	0.053228	0.042904	0.077044	0.079114	0.06902	2.39E-05	0.065852	9.65E-07
B2	0.042659	0.013045	0.015013	0.016517	0.006676	0.006823	0.007657	0.003398	0.009538	6.38E-06
B3	0.005892	0.065226	0.042992	0.058854	0.041113	0.043574	0.055992	1.25E-05	0.037244	0.000696
B4	0.005597	0.036962	0.024737	0.022235	0.030244	0.031306	0.031189	8.55E-06	0.025954	0.000511
B5	0.038298	0.013045	0.009213	0.007941	0.011437	0.011675	0.00878	1.81E-06	0.00868	0.000177
B6	0.017087	0.023916	0.008189	0.008622	0.011364	0.013533	0.016428	3.29E-06	0.010134	0.000202
B7	0.004042	0.065226	0.081207	0.074871	0.062237	0.061262	0.063884	0.000283	0.077733	1.31E-05
B8	0.041244	0.065226	0.014842	0.014747	0.009058	0.012375	0.029192	2.64E-06	0.009906	0.004849
B9	0.002357	0.039311	0.014672	0.013409	0.032496	0.036149	0.039741	1.09E-05	0.027186	6.1E-07
B10	0.007188	0.043484	0.013478	0.013137	0.033863	0.035891	0.035149	1.17E-05	0.028027	0.000569
B11	0.012373	0.014382	0.007677	0.005922	0.015159	0.015696	0.014548	4.52E-06	0.012039	2.68E-06
B12	0.000383	0.039136	0.012283	0.012025	0.041822	0.045645	0.055419	1.56E-05	0.036317	6.2E-07
A⁺	0.042659	0.065226	0.081207	0.074871	0.077044	0.079114	0.007657	0.003398	0.077733	0.004849
A⁻	0.000383	0.013045	0.007677	0.005922	0.006676	0.006823	0.06902	1.81E-06	0.00868	6.1E-07
W	0.074773	0.156432	0.114422	0.112091	0.130316	0.135406	0.142507	0.00341	0.125679	0.004965

The separation values can be measured using the Euclidean distance, which is given as:

$$S_k^+ = \sqrt{\sum_{j=1}^m [r_{kj}(x) - r_j^+(x)]^2}, \quad k = 1, \dots, n$$

$$S_k^- = \sqrt{\sum_{j=1}^m [r_{kj}(x) - r_j^-(x)]^2}, \quad k = 1, \dots, n$$

The similarities to the PIS can be derived as:

$$C_k^* = S_k^- / (S_k^+ + S_k^-), \quad k = 1, \dots, n,$$

Where $C_k^* \in [0, 1] \quad \forall k = 1, \dots, n,$

Finally, the preferred orders can be obtained according to the similarities to the PIS C_k^* in descending order to choose the best alternatives. Table 5. Illustrates the separation values and final rank.

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V. VIKOR METHOD

It developed for MC optimization of complex system. It determines the compromise ranking list, the compromise solution, and weight stability intervals for performance stability of the compromise solution obtained with the initial or calculated weights. The compromise ranking algorithm VIKOR has the following steps: Compute the value of S_k and R_k , $k = 1, 2, \dots, n$.

Compute the values S_k and R_k $k = 1, 2, \dots, n$, by the relations

$$S_k = \sum_{j=1}^m w_j |f_j^* - f_{kj}| / |f_j^* - f_j^-|, \text{ shown as in the average gap,}$$

$$R_k = \max_j \{ |f_j^* - f_{kj}| / |f_j^* - f_j^-| \mid j = 1, \dots, m \}, \text{ shown as maximal gap for improvement priority, where } w_j \text{ are the weights of criteria, expressing their relative importance.}$$

2. Compute the value of Q_k

3. Sorting by the values S, R, and Q in decreasing order the results are three ranking lists.

Compute the value Q_k , $k = 1, 2, \dots, n$, by the relation

$$Q_k = v(S_k - S^*) / (S^- - S^*) + (1 - v)(R_k - R^*) / (R^- - R^*),$$

$k = 1, 2, \dots, m$ (Alternatives)

Table 5: The TOPSIS Parameters and Ranking

Bi	S ⁺	S ⁻	C	R
B1	0.084956	0.140096	0.622506	2
B2	0.159253	0.075703	0.322202	8
B3	0.098118	0.101611	0.508744	3
B4	0.125987	0.06357	0.33536	5
B5	0.161431	0.071548	0.307101	9
B6	0.159296	0.056919	0.263253	11
B7	0.072275	0.154085	0.680708	1
B8	0.148906	0.078547	0.345333	4
B9	0.133978	0.059374	0.307075	10
B10	0.130837	0.064533	0.330313	7
B11	0.160974	0.057225	0.262259	12
B12	0.132515	0.066561	0.334349	6

Where:

$S^* = \min_k S_k$ or let $S^* = 0$ be zero gap, i.e., achieve the aspired level,

$S^- = \max_k S_k$ or let $S^- = 1$ be the worst level,

$R^* = \min R_j$ or let $R^* = 0$ be zero gap, i.e., achieve the aspired level,

$R^- = \max R_j$ or let $R^- = 1$ be the worst level, Let $v = 0.5$

Therefore, we also can re-write $Q_k = vS_k + (1 - v)R_k$, when $S^* = 0$, $S^- = 1$, $R^* = 0$, $R^- = 1$. v is introduced as the weight of the strategy of “the majority of criteria” (or “the maximum group utility”), here $v = 0.5$.

1. Rank the alternatives, sorting by the values S, R, and Q, in decreasing order. The results are three ranking lists.

2. Propose as a compromise solution the alternative (a'), which is ranked the best by the measure Q (minimum) if the following two conditions are satisfied:

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Table 6: The Different Values of Si

Si	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
1	0.067843	0	0.043539	0.05197	0	0	0.142507	0.003388	0.021624	0.004965
2	0	0.156432	0.103006	0.094866	0.130316	0.135406	0	0	0.124118	0.004959
3	0.065029	0	0.059467	0.02604	0.066541	0.066569	0.112251	0.003399	0.073691	0.004254
4	0.06555	0.084734	0.087874	0.085571	0.08667	0.089546	0.054649	0.003403	0.094239	0.004443
5	0.007712	0.156432	0.112032	0.108808	0.121499	0.126317	0.002608	0.00341	0.125679	0.004785
6	0.045228	0.123842	0.113625	0.107701	0.121635	0.122836	0.02037	0.003409	0.123032	0.00476
7	0.068301	0	0	0	0.02742	0.033438	0.130579	0.003128	0	0.004953
8	0.002501	0	0.103272	0.097743	0.125905	0.125005	0.050011	0.003409	0.123447	0
9	0.071282	0.077692	0.103537	0.099919	0.082498	0.080475	0.07451	0.003401	0.091998	0.004965
10	0.062736	0.06518	0.105395	0.100361	0.079967	0.080958	0.063847	0.0034	0.090467	0.004383
11	0.053565	0.152424	0.114422	0.112091	0.114605	0.118786	0.016005	0.003407	0.119566	0.004963
12	0.074773	0.078216	0.107254	0.102169	0.065228	0.062688	0.110921	0.003396	0.07538	0.004965

Table 7 : Compute the Different Parameters of VIKOR

Bi	SUM (S_i)	R_i	Q_i	Rank(Q)	Compromise Solution
B1	0.335835	0.142507	0.674697	1	2
B 2	0.749104	0.156432	0.943977	3	3
B 3	0.477242	0.112251	1.048382	6	5
B 4	0.656679	0.094239	1.358717	12	11
B 5	0.769281	0.156432	0.96259	4	4
B 6	0.786438	0.123842	1.240425	8	8
B 7	0.267819	0.130579	0.707849	2	1
B8	0.631292	0.125905	1.080725	7	7
B9	0.690277	0.103537	1.31496	11	12
B10	0.656695	0.105395	1.269041	10	9
B11	0.809834	0.152424	1.032227	5	6
B12	0.68499	0.110921	1.250721	9	10

The compromise solution between B1, and B7 where the Q (B7- (B1) not more than (1/11), then B7 is the best alternative successive by B1.

Table 8: Critical S and critical R

Critical S		Critical R	
S*	0.267819	R*	0.094239
S-	0.809834	R-	0.156432

VI. DIA METHOD

We present the DIA algorithm which aims at selecting the best interface while ensuring no ranking abnormality problem and provide a good accuracy in identifying the alternative ranks. As TOPSIS, DIA determines the positive and negative ideal alternative attribute values of each attribute. These are the maximum and minimum values of attribute in each column of the MADM matrix. While TOPSIS uses the positive ideal solution values to calculate in the m-dimensional space the Euclidean distance between the solutions and the ideal solution, DIA uses the Manhattan distance to calculate the distance between the attribute values and the positive and negative ideal values of each attribute.

International Journal of Innovative Research in Science, Engineering and Technology

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$$D_j^+ = \sum_{i=1}^m |V_{ij} - a_i^+|, \quad D_j^- = \sum_{i=1}^m |V_{ij} - a_i^-|$$

If we consider the (a_i^+, a_i^-) plane, the point $(\min a_i^+, \max a_i^-)$ is defined as the “positive ideal alternative”.

Table 9 : DIA Parameters and Ranking

Bi	D ⁺	D ⁻	R _i	Rank
B1	0.179771	0.338485	0.062675	2
B2	0.392426	0.125829	0.363415	9
B3	0.258833	0.259422	0.174486	3
B4	0.352077	0.166178	0.306353	4
B5	0.406755	0.1115	0.383679	10
B6	0.421822	0.096433	0.404987	11
B7	0.135453	0.382802	0	1
B8	0.355383	0.162872	0.311028	5
B9	0.372593	0.145662	0.335367	8
B10	0.357944	0.160311	0.31465	6
B11	0.429737	0.088518	0.41618	12
B12	0.366236	0.152019	0.326376	7
Critical D	0.135453	0.382802		
	Min	max		

The best alternative has the shortest distance to the PIA, which calculated as follow:

$$R_j = \sqrt{(D_j^+ - \min(D^+))^2 + (D_j^- - \max(D^-))^2}$$

The alternative having the smallest R_j value has the shortest distance to the PIA. The ranking order of the alternative due the shortest distance to the PIA. The final ranks by three different method illustrates in Table 10.

Table 10 : Rank the Bank by Three Methods

Bi	Rank by (TOPSIS)	Rank by (VIKOR)	Compromise solution (VIKOR)	Rank (DIA)
B1	2	1	2	2
B2	8	3		9
B3	3	6		3
B4	5	12		4
B5	9	4		10
B6	11	8		11
B7	1	2	1	1
B8	4	7		5
B9	10	11		8
B10	7	10		6
B11	12	5		12
B12	6	9		7

VII. CONCLUSION

Three different methods (TOPSIS, VIKOR, and DIA) strengthening the integrity of the decision making model. The case study of ranking banks illustrate that no large difference between three tools (TOPSIS, VIKOR, and DIA) in select

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the extreme alternative, the best or the worst. When the information of criteria are nearly the parameters may be dense and ranking of alternative need more effective criteria and remove other criteria. In DIA algorithm, if the removed alternative includes one of negative ideal attributes, all distances D_j of the alternatives to negative ideal alternative will increase uniformly with the same distance. The distance to the PIA is unchanged. Therefore, the ranking order of alternatives is also unchanged. The DIA algorithm is not subject to the ranking abnormality problem and outperforms TOPSIS algorithm. Table 11 illustrates the merits and demerits of the adopted methods in our study.

Table 11: The Merits and Demerits Of MADM Methods

TOPSIS	VIKOR	DIA	FAHP
Easy to calculate and understand One parameter Relative closeness May be Ranking abnormality	Easy to calculate and understand Three parameters (Compromise solution) May be Ranking abnormality	1.Easy to calculate and understand 2. One parameter 3. little ranking abnormality	1. Highly complex methodology and requires more numerical calculations 2. One criteria weights were computed.

REFERENCES

- [1] A.A. Rassafi and M. Vaziri, "Assessment of Modal Transportation Sustainability: Application of Data Envelopment and Concordance Analyses", Iranian Journal of Science & Technology, Transaction B, Engineering, Vol. 31, No. B2, pp. 179-193, The Islamic Republic of Iran, 2007.
- [2] Mei-Tai Chu , et al., "Comparison among three analytical methods for knowledge communities group-decision analysis", Expert Systems with Applications 33 (2007) 1011–1024
- [3] Serkan Ball and Serdar Korukoğlu, "Operating System Selection Using Fuzzy AHP And TOPSIS Methods", Department of Computer Engineering, Ege University, 35000, Bornova, Izmir, Turkey, Mathematical and Computational Applications, Vol. 14, No. 2, pp. 119-130, 2009.
- [4] N. Caterino, et al., "Comparative Analysis of Multi-Criteria Decision-Making Methods for Seismic Structural Retrofitting", Computer- Aided Civil and Infrastructure Engineering 24, 432–445, 2009.
- [5] Vijay M. A., Prasenjit C., and Shankar C., "Selection of Industrial Robots using Compromise Ranking Method", International Conference on Industrial Engineering and Operations Management, Dhaka, Bangladesh, January 9 – 10, 2010.
- [6] S.A. Nabavi Chashmi et al., "Evaluating & Ranking the Financial Performance of Bank after Privatization Using AHP FUZZY & TOPSIS Techniques", Advances in Environmental Biology, 6(1): 502-508, ISSN 1995-0756, 2012.
- [7] Dr Elsyed, Dr.A.K.Shaik Dawood. Dr Karthikeyan "Evaluating Alternatives through the Application of Topsis Method with Entropy Weight, International Journal of Engineering Trends and Technology, Volume-46 Number-2 2017,PP 60-66
- [8] Dr Elsyed, Dr.A.K.Shaik Dawood. Dr Karthikeyan "Fuzzy Measurement of University Students Importance Indexes by Using Analytical Hierarchy Process, International Refereed Journal of Engineering and Science (IRJES), Volume 6, Issue 1 (January 2017), PP.36-45.
- [9] Ali Mohaghar , et al., "Integration of Linear Goal Programming and Fuzzy VIKOR Method for Marketing Strategy Selection: A Case Study", Journal of American Science 8(6), 2012.