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Using of MCDM Approaches for Ranking of Managers (Case Study: Staff of Oil Industry's)

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ABSTRACT

In administration of organizations, securing manpower has not been new and has been considering since early ages. What is new in this subject todays, is maintaining of manpower. One of the determinatig factors in this function, is proportion between personal conditions and the condition of their jobs and job environments. Because of this importance, organizations should employ persons whose conditions are more and more proportionate to aforesaid conditions.
This paper contains results of ranking 5 staff managers of aforesaid organization regarding 7 criteria of job proportionate. Criterions are: job fitness, self-confidence, person's relish and inclination to job, verbal competence, communication ability, ability of dominating self-feelings and achievement motivation.
These criterias are designed by a number of experts of organization (and following actions are taken):
1. Criterias are weighted by application of entropy.
2. The selections are compared by 5 multi criteria decision making techniques: TAXONOMY,ELECTRE,TOPSIS,SAW and AHP, regarding obtained weights.
3. Accomplishing final grading.
KEYWORDS: Ranking, staff managers, job congruence, Multiple Criteria Decision Making (MCDM).

1. INTRODUCTION

In today's world, working forces available in organizations are of considerable importance because achieving sustainable utilization, creativity and innovation and the suitable quality of the organization expends on management and efficient human resources, effective, intelligent and committed [1]. As the result of this important finding it can be said that the process of employment of staff in the organization is one of the most important activities of a manager. One of the cases that should be considered in the recruitment process is the analysis of the desired jobs. Job analysis is a kind of process in which the nature and characteristics of each staff position within the organization is investigated, and about which sufficient information is gathered and, reported. By analyzing the various jobs, it becomes obvious that what position includes what tasks, and what is required to man that position, and what skills, knowledge and abilities are necessary [2].

For collecting data and necessary skills for the intended jobs, several methods such as observation, interview, questionnaires, meeting with professionals, and SAMT questionnaires' analyses are used. Job analysis consists of two stages, job descriptions and competency for the job. Adjusting the job qualification conditions for a specific job will be important because the individual chosen for the job would be the most suitable for the job, and its occupational environment. It is for this reason that the objective is to recently, a group of experts are formed to do psychological interviews with employees.

One of the organizations that have attempted such an endeavor in the past few years is the health and treatment organization in Oil Industry. After the verification of adoption of its statute by the Ministry of Oil, this organization has begun its official activities in 1950, and is recognized as an independent organization which is active in the field of health [3]. This organization accomplishes its Employment's activities through coordination with the ministry of oil by managing the tests and doing interviews. However, during the past two to three years, and in addition to the above, it has conducted professional job interviews for management positions. Each of these interviews is conducted by several experts, and consists of two parts, one is qualification interviews, and the other is work psychology interviews (for evaluating the suitability of people for the job, and the job environment), however the second part is more important.

The present survey intends to rank five applicants who have has been selected through initial tests and interviews which were based on indicators established by selected experts and decide whether these selectees are suitable for the job, as well as job and occupational environment, and finally choose the best one for the post of staff management which plays a major role in this organization. The research indicators have been obtained through the Delphi technique. Therefore, the overall objective of this research is as follows:
1. Interviews with experts and acquiring measuring-indicators appropriate to employee's positions

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2. Assess the indicators according to expert's views and indicator importance
3. Ranking the indicators according to obtained weights by multiple attribute decision making techniques in some cases, the making of these decisions have been very difficult, and cannot be done through normal analysis. To resolve these issues in recent decades, researchers focused on multiple criteria decision making models (MCDM)[1] for the more complex decision makings. These decision-making models are divided into broad categories, the multi-objective models[2] (MODM) and multiple attribute decision making models (MADM)[3] [4, 5]. The multi-objective models are used for designing, whereas multi-criteria models are applied to the more preferred options. MADM models can generally be divided into two broad categories [6]:
Non-compensatory model, including the methods in which the exchange of indicators is not permitted, in other words, the weakness of one indicator cannot be offset by the advantage in the other indicator. Thus, each of these indicators in these methods is utilized singly, and comparisons are made between single indicators respectively. However, compensatory model includes methods in which the transfer of indicators are possible, for example, a change in one indicator can be compensated by an opposing change in another or other indicators [7]. Some of these techniques are the ELECTRE, SAW, and the TOPSIS techniques.
One of the other of such methods used in this article is the AHP technique. In this technique, establishing preferences can be accomplished hierarchically through paired comparisons, and the communication with the main purpose of the issue with criteria and options. In this model, the overall issue is divided into several detailed sections. [8]. Basically, a multiple attribute decision making issue MADM can be summarized into a decision matrix, in which the rows are different options, and the columns are indicators that reveal the specific characteristics of the options. Also, the cells of decision matrix indicate the position of the options in the row relevant to the column indicators. [9].
There has been no research on the suitability of the individuals based on their job specification in the organizations, therefore, the present research, could provide a new idea for organizations to use the new methods for efficient staff employment.

2. METHODOLOGY OF RESEARCH

Present study is an applied type research, and is aimed to rank the various indicators of job suitability, with the final intension of choosing the best managers for employment. This study, in addition to helping the election of directors in the relevant organization, could also be used as a model for other similar organizations. The population for this study is the health department in the Oil Industry. It is to determine the employment status at that department, and the development of indicators, the interviews with responsible experts for that organization. To make the information complete, and to gather the information on each of these options, all the work psychology interviews have been collected and analyzed. Moreover, for group AHP technique, tables were designed and were shown to four renowned experts, so as to categorize the indicators based on their importance, as well as comparing different options by these experts.

3. The criteria determining the suitability of the job

Many factors and indicators can determining the suitability of the employees for the position, however, in this study, experts consensus define the indicators as follows:

1. Work compatibility: energy and capacity for accepting the constraints such as unfavorable weather conditions, living singly, harsh working conditions, and adjusting oneself with the conditions present in work environment

2. Confidence: The rate of self-confidence of the individual, and relying on capabilities, skills and talents, clear straight forward utterance, and accepting criticism

3. The level of interest and willingness of the individual to the job: interest rate and motivation, acceptance and participation in organization work conditions, including service area, the nature of work and ...

4. Verbal ability: health status, and verbal fluency, logical and coherent process in speech and self-composed speech

5. Communication skill: ability to express themselves correctly, and with a logical sequence, not necessitates the repetition of question

6. Dominance on emotions and feelings: the ability of self- control when faced with failure, as being rejected in an interview

7. Motivation for progress: Evaluation of the individual's background in terms of employment, science, sports, tendency to grow to higher levels of the organization and...

At first, and because of the fact that these indicators are all qualitative, bipolar scale was used to change to quantitative indicators, and then they were given weight through ENTROPY technique, and finally, by using the five mentioned technique they are evaluated and compared.

4. Analyses of the data

After obtaining a decision matrix emanating from the experienced managers and experts and converting the matrix data to quantitative tables respectively, table1 was formed. In this table rows indicate options and columns respectively represent proposed indicators.

[1] Multiple Criteria Decision Making
[2] Multiple Objective Decision Making
[3] Multiple Attribute Decision Making

	X1	X2	X3	X4	X5	X6	X7
M1	7	7	7	9	7	7	7
M2	5	9	7	9	7	7	7
M3	7	3	5	9	7	5	5
M4	5	7	7	5	5	7	7
M5	5	9	5	7	7	5	7

Table. 1. The primary matrix showing experts' opinion for the indictors.

In this table and the other tables, Xi represents (i_{th}) indicators, and Mi represents the (i_{th}) options respectively.

4.1 weighted index of entropy (ENTROPY)

In this section, Shannon ENTROPY is used as a weighting criteria of the indicators by applying the primary decision matrix, and then, normalized matrix (pij) as in table2 is obtained.

	X1	X2	X3	X4	X5	X6	X7
M1	0.2413	0.2	0.2258	0.2307	0.2121	0.225	0.2121
M2	0.1724	0.2571	0.2258	02307	0.2121	0.225	0.2121
M3	0.2413	0.0857	0.1612	0.2307	0.2121	0.161	0.1515
M4	0.1724	0.2	0.2258	0.1282	0.151	0.2258	0.2121
M5	0.1724	0.2571	0.1612	0.1794	0.2121	0.161	0.2121

Table. 2. A normalized matrix

In this method, firstly, the decision matrix is normalized using the hourly norms, then, the values of Wj , and dj and Ej are obtained using the following formulas.

(Shannon equation)

$$E_j = -\frac{1}{\ln m}\sum_{i=1}^{m}(p_{ij} Ln p_{ij})$$

$$d_j = 1 - E_j$$

$$w_j = \frac{d_j}{\sum d_j}$$

ENTROPY for each index (Ej), the degree of deviation (dj), and weights of each indicator (Wj) is shown in table3.

	X1	X2	X3	X4	X5	X6	X7
Ej	0.996	0.971	0.997	0.995	0.998	0.994	0.973
dj	0.004	0.029	0.003	0.005	0.002	0.006	0.027
Wj	0.052	0.381	0.039	0.065	0.028	0.079	0.355

Table. 3. Values for Wj, dj, Ej

Finally, using ENTROPY method, the sequence of indicators based on their weights, are shown as follows:

W2> W7> W6> W4> W1> W3 >W5

4.2 ranking of options using SAW method in this method, firstly, using the linear norm, we normalize the matrix. Normalized matrix is shown in table4.

	X1	X2	X3	X4	X5	X6	X7
M1	1	0.778	1	1	1	1	1
M2	0.714	1	1	1	1	1	1
M3	1	0.334	0.714	1	1	0.714	0.714
M4	0.714	0.778	1	0.556	0.714	1	1
M5	0.714	1	0.714	0.778	1	0.714	1

Table 4: The normalized matrix

Subsequently, the weights obtained by Shannon's ENTROPY is multiplied by normal matrix, and we obtain the linear mean, next, whichever option that has a higher mean will have a higher priority.

M1=0.914 M2=0.984 M3=0.609

M4=0.862 M5=0.986

Therefore we will have: M5>> M2>> M1>> M4>> M5

4.3 ranking of options with TOPSIS method

According to this method, the normalized decision matrix which is in the form of Euclidian matrix is shown in table5.

	X1	X2	X3	X4	X5	X6	X7
M1	0.175	0.175	0.175	0.225	0.175	0.175	0.175
M2	0.125	0.225	0.175	0.225	0.175	0.175	0.175
M3	0.175	0.075	0.125	0.225	0.175	0.125	0.125
M4	0.125	0.175	0.175	0.125	0.125	0.175	0.175
M5	0.125	0.225	0.125	0.175	0.175	0.125	0.175

Table. 5. Normalized Euclidian matrix norm

Subsequently, using table3, which shows the weight of the indicators acquired by ENTROPY method, the weights of normalized matrix is obtained.

	X1	X2	X3	X4	X5	X6	X7
M1	0.0091	0.0667	0.0667	0.0146	0.0049	0.0138	0.0622
M2	0.0065	0.0858	0.0068	0.0146	0.0049	0.0138	0.0622
M3	0.0091	0.0286	0.0048	0.0146	0.0049	0.0098	0.0444
M4	0.0065	0.0667	0.0068	0.0081	0.0035	0.0138	0.0622
M5	0.0065	0.0858	0.0048	0.0114	0.0049	0.0098	0.0622

Table. 6. Weighted decision matrix

Using (c_i) equation which is known as the relative proximity helps us to determine d_i^-, representing the distance to negative ideal, and d_i^+ , representing the distance to positive ideal.

The distance to negative ideal

$$d_i^- = \sqrt{\left(\sum V_{ij} - V_i^-\right)^2}$$

The distance to positive ideal

$$d_i^+ = \sqrt{\left(\sum V_{ij} - V_i^+\right)^2}$$

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

With regards to the relative proximity of five options to the ideals, the results are as follows:

C1=0.69, C2=0.95, C3=0.1, C4=0.67, C5=0.93

The ideal distance to negative distance to the ideal of positive proximity equation considering the fact that the more the distance of options to ideals, the higher the ranking of the option, therefore, the rankings are as follows:

M1>> M4>> M3 M5>> M2>>

4.4 ranking of options with ELECTRE

This technique is based on paired comparisons options. In this method, such as in TOPSIS, normalized weighted matrix is achieved (table 6).

Afterwards, the series of coordinated and uncoordinated collection are specified for each indicator, subsequently, by using the following equations, the coordinated and uncoordinated collection matrix is obtained.

Coordinated matrix elements

$$I_{k,l} = \sum w_j$$

Uncoordinated matrix elements

$$NI_{k,l} = \frac{Max\left|V_{kj} - \bar{V}_{lj}\right|}{Max\left|V_{kj} - V_{lj}\right|}$$

These matrices include:

	M1	M2	M3	M4	M5
M1	--	0.619	1	1	0.619
M2	0.381	_	0.947	1	1
M3	0	0.052	_	0.145	0.261
M4	0	0	0.854	_	0.522
M5	0.381	0	0.736	0.474	_

Table. 7. Coordinated matrix (I)

	M1	M2	M3	M4	M5
M1	_	1	0	0	1
M2	0.136	_	0.045	0	0
M3	1	1	_	1	1
M4	1	1	0.17	_	1
M5	0.167	1	0.056	0.21	_

Table. 8. Uncoordinated matrix (NI)

Afterwards, the numbers in the matrices are compared with the thresholds obtained from the following relationships (I^-, N^-I^-), from which effective coordinated matrix, and effective uncoordinated are established. (tables 9 and 10)

$$\bar{I} = \frac{\sum_{k=1}^{m}\sum_{l=1}^{m} I_{k,l}}{m(m-1)}$$

$$\bar{NI} = \frac{\sum_{k=1}^{m}\sum_{l=1}^{m} NI_{k,l}}{m(m-1)}$$

Comparisons of coordinated elements

$$\begin{cases} I_{k,l} \geq \bar{I} \rightarrow f_{k,l} = 1 \\ I_{k,l} < \bar{I} \rightarrow f_{k,l} = 0 \end{cases}$$

Comparisons of uncoordinated elements

$$\begin{cases} NI_{k,l} \leq \bar{NI} \rightarrow g_{k,l} = 1 \\ NI_{k,l} > \bar{NI} \rightarrow g_{k,l} = 0 \end{cases}$$

	M1	M2	M3	M4	M5
M1	_	1	1	1	1
M2	0	_	1	1	1
M3	0	0	_	0	0
M4	0	0	1	_	1
M5	0	0	1	0	_

Table. 9. Effective coordinated matrix (- f)

	M1	M2	M 3	M4	M5
M1	_	0	1	1	0
M2	1	_	1	0	0
M3	0	0	1	0	0
M4	0	0	_	_	0
M5	1	0	1	1	_

Table. 10. Effective uncoordinated matrix (g)

Finally, the overall effective matrix which the result of equation $h_{k,l} = f_{k,l} * g_{k,l}$ (Multiplying the corresponding entries by (K) rows, and (L) columns gives us two effective coordinated and effective uncoordinated matrices) as follows:

	M1	M2	M3	M4	M5
M1	_	0	1	1	0
M2	0	_	1	0	0
M3	0	0	_	0	0
M4	0	0	1	_	0
M5	0	0	1	0	_

Table. 11. The overall effective matrix

With regards to the fact that, the ranking method accomplished is based on the number of zeroes in the columns, therefore, the options first, second and fifth are ranked as equals, and only one of them is presented here.

M1>> M2>> M5>> M4>> M3

4.5 ranking of options with TAXONOMY method

To solve the problem using this technique, firstly, we obtain the initial normal matrix values through the following equation. (o^-, and x^-) represent the mean average of each column, and standard deviation are each entry respectively.

$$z = \frac{x_i - \bar{x}}{\sigma}$$

	X1	X2	X3	X4	X5	X6	X7
M1	1.095	0	0.73	0.61	1.12	0.73	0.21
M2	-0.73	0.81	0.73	0.61	1.12	0.73	0.21
M3	1.095	-1.63	-1.095	0.61	1.12	-1.095	-0.84
M4	-0.73	0	0.73	-1.43	-1.8	0.73	0.21
M5	-0.73	0.81	-1.095	-0.41	1.12	-1.095	0.21

Table. 12. The initial normalized matrix

Afterwards, to eliminate the non-homogenous options through calculating the Euclidian distance of coupled options, we obtain the high and the low by using the following formulas, and then we eliminate the options which do not fall into this limit. Euclidian distance for coupled options is shown in the image below.

	M1	M2	M3	M4	M5	R_i
M1		1.99	3.23	4	3.42	1.99
M2	1.99		4.13	3.65	2.77	1.99
M3	3.23	4.13		5.5	3.38	3.23
M4	4	3.65	5.5		4.11	3.65
M5	3.42	2.77	3.38	4.11		2.77

Table 13: Euclidian distance for coupled options.

$$\bar{R} = 2.726 \qquad s_{Ri} = 0.741$$

$$\begin{cases} L=1.244 \\ U=4.208 \end{cases} \longrightarrow \begin{cases} L=\bar{R}_{-2}\, s_{Ri} \\ U=\bar{R}_{+2} \end{cases}$$

These limits indicate that none of the options can be removed. In continuation, we obtain (gi) for each option from the normalized table according to the following formula, then, we calculate the mean and standard deviation for them.

Subsequently, using the following formula:

$$gi = \sqrt{\sum (Zij - Oj)^2}$$

We obtained (yi) for each option using the following formula; and the options which have a lower (yi) value are of a higher rate.

$$Y_i = \frac{g_i}{\bar{g} + 2s_g}$$

	M1	M2	M3	M4	M5
gi	0.81	1.78	3.7	4.08	3.32
yi	0.147	0.323	0.671	0.74	0.6

Table. 14. (gi), and (yi) values.

Therefore, the ranking of the options would be as follows:

M1>> M2>> M5>> M3>> M4

4.6 Ranking of options using the AHP group method.

To solve the problem using AHP group technique, firstly, the matrices for the preference between indicators matrix, and preferences between options matrix for every indicator is constructed. In this study, these tables are given to four certified

relevant persons, and then to integrate the geometric mean, the opinions of experts have also been taken. In the next step, these matrices are normalized by hourly norms. The results of this operation are displayed in the normalized matrix below.

	X1	X2	X3	X4	X5	X6	X7
X1	0.0055	0.001	0.03	0.21	0.0016	0.046	0.027
X2	0.03	0.0055	0.02	0.0776	0.087	0.023	0.0077
X3	0.001	0.00014	0.0055	0.0673	0.0562	0.019	0.011
X4	0.00014	0.0004	0.00047	0.0055	0.0063	0.000065	0.004
X5	0.019	0.00034	0.00053	0.0047	0.0055	0.0047	0.15
X6	0.0064	0.0013	0.0016	0.046	0.0063	0.0055	0.0012
X7	0.00112	0.0038	0.0027	0.0075	0.00019	0.025	0.0055

Table. 15. Normalized matrix of preferences between indicators

Subsequent to normalizing the indicators matrix, we normalize the option matrices according to the terms of our normal indicators. For example, in the following, preference normalized matrix between the options is displayed according to the compatibility of the job.

	X1	X2	X3	X4	X5
X1	0.016	0.114	0.08	0.14	0.098
X2	0.0023	0.016	0.00474	0.057	0.127
X3	0.0033	0.057	0.016	0.04	0.22
X4	0.0019	0.00475	0.0067	0.016	0.046
X5	0.0027	0.0021	0.0012	0.0058	0.016

Table. 16. Preferences normalized matrix between the options based on the compatibility of career and jobs.

Subsequently, in the next step, we calculate the mean normalized matrix, and use them as indicator weight, or the coefficient, to determine their importance. Following that, we use matrix multiplication to multiply weight indicators by weight options, this way; the options with higher weight will have higher priority. Therefore, we will have:

$$\begin{pmatrix} 0.0112 \\ 0.0139 \\ 0.0061 \\ 0.00405 \\ 0.00396 \end{pmatrix}$$

M2>>M1>>M3>>M4>>M5

4.7 Final rankings of options by Copland method.

In this method, and losers and winners of each option are prepared compared to other options, then, the difference between winning and losing, specifies the rating each option. The results of these operations have been shown in the table below:

	M1	M2	M3	M4	M5	$\sum w - \sum d$
M1	_	D	W	W	_	* 1
M2	W	_	W	W	W	4
M3	D	D	_	D	D	-4
M4	D	D	W	_	D	-2
M5	* _	D	W	W	_	`

Table 17: scores of options using Copland method

In this matrix, and because two options of one and five are identical, the preferences are equal between the two options. As a result, they are not comparable.

Therefore, the final ranking of options is as follows:

M2>>M1=M5>>M4>>M3

5. Conclusion

Nowadays, the recruitment of qualified staff in organizations is of prime importance, because the wrong choice for the organization can bring heavy costs to the organization. To employ logical persons, many methods have been developed in today's world, and one of these techniques, is the multiple attribute decision making techniques to select one option from among several options. The reason for choosing multiple attribute decision making to select staff is a change in employment attitude. According to the managers' point of views in the organization, it is a mistake to employ people solely by judging their test scores. As was indicated, these personnel were evaluated according to the 5 technique, and the final result of rankings was achieved through the integration of these methods called Copland technique.

Since these techniques are based on different criteria of carried weights, they can render more precise results as compared to other methods. but because the weights are based on expert opinion, However, these weightings are based on the specialists, and experts point of views, therefore, they might not be exactly right, and without any errors, especially in AHP technique group, because indices are weighted based on expert opinion, and naturally enough people are different, and could cause errors.

One of the many recommendations to managers of these organizations is that in addition to these techniques, other methods be used as well to assess employees' conditions. For example, we can use the techniques of observing the work of people, studying their work records, and so on.

The results of this study and its advantages can be applied to employment in other industries, companies and organizations, because it can be a basis for recruiting more suitable personnel for the organizations.

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