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ANALYSIS OF WORK FORCE MANAGER USING MCDM TECHNIQUES

MCDM Techniques

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Abstract *:* MCDM problems are more complicated in the work environment and generally ona large scale. In order to deal with uncertainty and subjectivity MCDM Evidence Reasoning was created, designed and finally implemented in Intelligent Decision systems, window – based software. This multi – criteria study understands the needs for MCDM, several projects were proposed to simplify the problems optimally by different methods and each of the MCDM methods has its own unique features. Many applications use MCDM to identify system defects and these defects can be handled with the correct solution method.

IndexTerms - MCDM, Decision systems, ANP method .

INTRODUCTION:

The choice of two or more measure is a decision making process. In addition, it should always be realized that between the available options, there may not always be 'a proper' choice.There might have been a better choice which was not considered or the right information at that time was not available. Multiple assessment criteria problems consist only of a limited number ofalternatives that were explicitly known at the beginning of the solution process. There are not explicit identifying alternative solutions by a number of design criteria (multiple mathematical programming problems). The solution of a statistical model can be found as an alternative. The current number of alternatives appears both to be infinite or unrecognizable (where some variablesare continuous) or typically to be very large (where all parameters are dubious). However both types of problems are a multi – criteria subclass. In order to determine the weight of options the MCDM problems can also be classified into two main classes: discretionary and derogatory. The basic concept of any MCDM method is the same: selection of criteria, choice of alternatives, and selection of methods of diffusion and of course, choice of weight or excess weight alternatives.

MCDM problems are more complicated in the work environment and generally ona large scale. In order to deal with uncertainty and subjectivity MCDM Evidence Reasoning was created, designed and finally implemented in Intelligent Decision systems, window – based software.

This multi – criteria study understands the needs for MCDM, several projects were proposed to simplify the problems optimally by different methods and each of the MCDM methods has its own unique features. Many applications use MCDM to identify system defects and these defects can be handled with the correct solution method.

OBJECTIVES:

1. To identify the correct way of making a decision.
2. To use MCDM techniques in multilevel management of common hierarchy.
3. To take simple values as linguistic variables to enhance the significance of MCDMtechniques.

1.Literature Review:

1.1.The ANP methods

ANP METHOD IS ONE OF THE MULTI CRITERIA METHODS FOR THE STATEMENTS WHICH LEAD TO COMPLEXMETHOD SOLVING OF CRITERIA WHICH HAS DIFFERENT VARIABLES AND ALTERNATIVES WHICH COMPRISES IN ANY MANAGEMENT LEVEL O R IN ANY INDUSTRY. AS STATED BY JIANN LIANG YANG, GWO – H SHIUNG TZENG ANINTEGRATED TECHNIQUE FOR MCDM USING ANP METHOD TO MINIMIZE THE PROBLEM BASED ON DEPENDENCEAND FEEDBACK AMONG THE CRITERIA AND ALTERNATIVES. SO THIS MCDM IS CATEGORIZED ON BASIS OF THIS FOR THE MANAGEMENT TO DOWN THE RESTRICTIONS FOR THE STRUCTURED DEVELOPED. DECISION MAKING STRUCTURE CAN BE OBTAINED WITH THE FORMATION OF STRUCTURE BASE ON THE AVAILABLE DATA AND INTERRELATIONS BETWEEN THEM.

1.2.THE AHP METHOD

AHP method is one of the main hierarchy methods of solving complex decision making problems of authority and thereby it produces the best decision by setting up various priorities which comes under level of degree. As stated by D.Y. Chang (1996), the extend analysis method of Fuzzy AHP. A.H.I. Hee (2009), Fuzzy supplier selection considering the costs benefits, risks and opportunities. M.Zeyan, C. Colpan (2011), Supplier performance evaluation similarly made an analysis for quantitative and qualitative factors of making the proper decision making.

When crossing upon the fundamental factors of fuzzy logic it shows, the mathematical analytic process of setting up the method which the problem must be solved. They give numbers in numerical to make it simple and changes those to a matrix form for which the different level ofdegree and important alternatives values are given. AHP method becomes common and famous hierarchical structure and was applied to various project parameters and selection process. The ANP is the general form derived from AHP Satty, 1990 which has been used for MCDM.

1.3.THE DEMATEL METHOD:

DEMATEL method is mainly used for research purpose which has different problems groups which has complex cause and effect. This method is further changed to matrix order of weights given to different perspective and to calculate the relationships between them regarding to the importance.

1.4.THE TOPSIS AND VIKOR METHOD:

The decision reached during meetings is sometimes assumed to be better than that of its most capable or knowledgeable members. This may be a main reason to convene a meeting, although representation, exchange of knowledge and commitment to implementation of decisionscan be other reasons. The importance of studies of the effectiveness of groups compared with individuals is clear, given that managers have been observed to spend much of their time in meetings. (Rice, 1973)

Let ‘X’ be a universal set. Then the Fuzzy subset A of X is defined by its membership function.

μ_A ; X_{MA} [0,1] which assign a real number μA(X) in the interval [0,1] to each element X μ_AX, where the value of □A (X) at Xshows the grade of membership of X in A.
The support of a Fuzzy set A defined on X is a crisp set defined as

Supp (A) = $\{X \varepsilon X: \mu(X) > 0\}$

These values re cannot be calculated without having set of variables, so we use the linguistic scale values to these variables. These scales are determined with the data as low mediumand high variable scales. These values are determined in the case to find out the other axis valuesof the measurement to the real number μ_A which we further use in this method called fuzzy logic.

Instead of making the uncertain values into a measurable one we have to make them as andetermined values. When using these scales values for the axis of measurement these variables hasset of interval lies between the Fuzzy set where the values are determined and make them into a crisp value.

These fuzzy number has the triplet number which has the defined values as a,b,c. These setvalues are defined in the limits for which the values are determined to the uncertain measurementdata of fuzzy set.

2.Importance of Linguistic Scale

Linguistic Scale is a hierarchical order for the units or values which are determined to have a value for the logical and analytical method where the uncertain values are being determined. Weare presenting a fuzzy linguistic approach, which uses two-fold fluent language terms and supportsthe selection of appropriate human resources based on their knowledge and skills required for eachtask of the project.

Result Analysis:

Dematel

Criteria names

Label	Name
1	Manager
2	Supervisor
3	Worker

Linguistic variables

Linguistic variable	Fuzzy number
No influence	(1.00, 1.00, 1.00)
Very low-influence	(2.00, 3.00, 4.00)
Low influence	(4.00, 5.00, 6.00)
High influence	(6.00, 7.00, 8.00)
Very high influence	(8.00, 9.00, 9.0)

Table : Pairwise comparisons:

Expert 1	C_1	C_2	C_3
C_1	(0.00, 0.00, 0.00)	(2.00, 3.00, 4.00)	(4.00, 5.00, 6.00)
C_2	(2.00, 3.00, 4.00)	(0.00, 0.00, 0.00)	(4.00, 5.00, 6.00)
C_3	(6.00, 7.00, 8.00)	(4.00, 5.00, 6.00)	(0.00, 0.00, 0.00)

Expert 1	C_1	C_2	C_3
C_1	(0.00, 0.00, 0.00)	(2.00, 3.00, 4.00)	(4.00, 5.00, 6.00)
C_2	(4.00, 5.00, 6.00)	(0.00, 0.00, 0.00)	(4.00, 5.00, 6.00)
C_3	(4.00, 5.00, 6.00)	(6.00, 7.00, 8.00)	(0.00, 0.00, 0.00)

$$\sim = \frac{x^{\sim 1} \oplus x^{\sim 2} \oplus x^{\sim 3} \ldots \oplus x^{p}}{Z \qquad v}$$ p: number of expert

Mean of pairwise comparisons

	C_1	C_2	C_3
C_1	(0.00, 0.00, 0.00)	(2.00, 3.00, 4.00)	(4.00, 5.00, 6.00)
C_2	(3.00, 4.00, 5.00)	(0.00, 0.00, 0.00)	(4.00, 5.00, 6.00)

C_3	(5.00, 6.00, 7.00)	(5.00, 6.00, 7.00)	(0.00, 0.00, 0.00)

$r = \max_{1} \leq I \leq n\ (\sum^{n} = 1 u_{ij})$

Normalized matrix:

	C_1	C_2	C_3
C_1	(0.00, 0.00, 0.00)	(0.14, 0.21, 0.29)	(0.29, 036, 0.43)
C_2	(0.21, 0.29, 0.36)	(0.00, 0.00, 0.00)	(0.29, 036, 0.43)
C_3	(0.36, 0.43, 0.50)	(0.36, 0.43, 0.50)	(0.00, 0.00, 0.00)

Total – relation fuzzy matrix

	C_1	C_2	C_3
C_1	(0.23, 052, 1.37)	(0.34, 066, 1.51)	(045, 0.78, 1.66)
C_2	(0.43, 0.79, 1.72)	(0.23, 0.52, 1.37)	(0.48, 0.83, 1.75)
C_3	(0.59, 0.99, 2.05)	(056, 0.94, 1.94)	(033, 0.69, 1.71)

Importance and cause – effect table (fuzzy)

Criteria	$\tilde{D} + \tilde{R}$	$\tilde{D} + \tilde{R}$
C_1	(2.28, 4.27, 9.68)	(-4.12, -0.34, 3.28)
C_2	(2.27, 4.26, 9.66)	(-3.67, 0.02, 3.72)
C_3	(2.74, 4.91, 10.82)	(-3.64, 0.32, 4.44)

B = defuzzy $(\tilde{A})$ if

$\tilde{A} = (a_1, {}_2, a_3)$

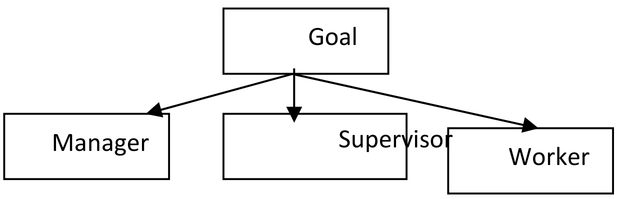
$$B = \frac{(a_1 + a_3 + 2 \times a_2)}{4}$$

Importance and cause – effect table (crisp)

Criteria	$(\tilde{D}_i + \tilde{R}_i)^{def}$	$(\tilde{D}_i + \tilde{R}_i)^{def}$
C_1	5.12	-0.38
C_2	5.11	0.02
C_3	5.84	0.36

EFFECT (Vs) IMPORTANCE (DEMATEL)AHP

Hierarchy Structure



Linguistic variables

Code	Linguistic Variables	Fuzzy Number
1	Equal Importance	(1, 1, 1)
2	Weak importance	(2, 3, 4)
3	Strong importance	(4, 5, 6)
4	Demonstrated importance over other	(6, 7, 8)
5	Absolute importance	(8, 9, 10)

mean of pairwise comparisons with respect to goal

Goal	Manager	Supervisor	Worker	Sum
Manger	(4, 5, 6)	(0.25, 0.333, 0.5)	(8, 9, 10)	(12.25, 14.333, 16.5)
Supervisor	(2, 3, 4)	(4, 5, 6)	1, 1, 1)	(7, 9, 11)
Worker	(0.1, 0.111, 0.125)	(1, 1, 1)	(4, 5, 6)	(5.1, 6.111, 7.125)
		$cl^m = 5.497$ $cl^g = 14.518$Inconsistent		

Degree of preference with respect to goal

Goal	Manager	Supervisor	Worker	d^1	w/td>
Manger	1	1	1	1	0.74
Supervisor	0.351	1	1	0.351	0.26
Worker	0	0.48	1	0	0
		Sum		1.351	1

Matrix of final weight (criteria) with respect to goal

Component	Final weight
Manger	0.74
Supervisor	0.26
Worker	0

Final weight chart (criteria) with respect to goal

ANP

Criteria names and decision matrix

Criteria Name	
Label	Name
C_1	Workplace
C_2	Workplace

Decision matrix		
	C_1	C_2
N_1	1	2
N_2	2	1
N_3	2	2

$$P_{ij} = \frac{a_{ij}}{\sum_{i=1}^{m} a_{ij}}; \forall\, i,j$$

$$E_j = K \sum_{i=1}^{m} P_{ij}\, Ln\, P_{ij}, \forall, K = \frac{1}{i, Ln(m)} \text{(entropy)}$$

$$d_j = 1 - E\ ; \forall_j \text{ (uncertainly value)}$$

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j}; \forall \text{(weight)}$$

$$w_j^1 = \frac{\lambda_j w_j}{\sum_{i=1}^{n} \partial_i w_i}; \forall_j, \lambda_j \text{ subjective weight (adjusted weight)}$$

Final weightage

Table : Final answer Number	Criteria	Entropy Values	Uncertainly values	Criteria weights
1	C_1	0.96	0.04	0.426

2	C_2	0.946	0.054	0.574

Criteria names

Label	Name
C_1	0.2

Alternatives names

Label	Name
A_1	Manager
A_2	Supervisor
A_3	Worker

Linguistic variables

Linguistic variables Fuzzy number

Very Low	(0, 0.05, 0.15)
Low	(0.1, 0.2, 0.3)
Fairly low	(0.2, 0.35, 0.5)
Fair	(0.3, 0.5, 0.7)
Fairly good	(0.5, 0.65, 0.8)
Good	(0.7, 0.8, 0.9)
Very good	(0.85, 0.95, 1)

Decision matrix

	C_1
Criteria type	Positive
A_1	(0.1, 0.2, 0.317)
A_2	(0.433, 0.6, 0.767)
A_3	(0.8, 0.9, 0.967)

Criteria weights (1,1,1)

$\tilde{f}^*_j = \max_i \tilde{f}_{ij}$ i = 1, 2, …, n for j ∈ j^a benefit

$\tilde{f}^*_j = \max_i \tilde{f}_{ij}$ i = 1, 2, …, n for j ∈ j^b benefit

$\tilde{f}^*_j = \max_i \tilde{f}_{ij}$ i = 1, 2, …, n for j ∈ j^c benefit

if $\tilde{f}^0_j = (l^0_j, m^0_j, r^0_j)$ and $\tilde{f}^*_y = (l^*_j, m^*_j, r^*_j)$

$\tilde{d}_j = (\tilde{f}^*_j \ominus \tilde{f}_{ij}) / (r^*_j - l^0_j)$ for benefit

$\tilde{d}_j = (\tilde{f}_{ij} \ominus \tilde{f}^0_{ij}) / (r^0_j - l^*_j)$ for cost

Weighted normalized decision matrix

	C_1
A_1	(0.558, 0.808, 1)
A_2	(0.038, 0346, 0615)
A_3	(-0.192, 0, 0.192)

if $\tilde{R}_i = (R^l_i, R^m_i, R^r_i)$ and $\tilde{S}_i = (S^l_i, S^m_i, S^r_i)$

$\tilde{S}_i = \sum_{i=1}^{J} (\tilde{w}_j \otimes \tilde{d}_j)$

$\tilde{R}_i = \max_j (\tilde{w}_j \otimes \tilde{d}_j)$

if $\tilde{i} = (Q^l_i, Q^m_i, Q^r_i)$

$\tilde{Q}_i = v \frac{(\tilde{s}_i \theta \tilde{s}^*)}{s^0 r - s^* l} \oplus (1 - v) \frac{(\tilde{R}_i \theta \tilde{R}^*)}{R^0 r - R^* l}$

$\tilde{S}^* = min_i\ \tilde{s}_i$

$\tilde{S}^0 = max_i\ si^r$

$\tilde{R}^* = min_i\ \tilde{R}_i$

$\tilde{R}^0 = max_i\ R^r i$

v = 0.5

if $\tilde{N}$ a fuzzy number

$\tilde{N} = (l, m, r)$

crisp $(\tilde{N}) = \frac{2m+l+r}{4}$

S,R,Q values

	S	Sg	R	Rg	Q	Qg
A_1	(0.558, 0.808.1)	(0.793)	(0.558, 0.808, 1)	0.793	(0.306, 0.677, 1)	0.665
A_2	(0.038, 0.346, 0.615)	0.337	(0.038, 0.346, 0.613)	0.0337	(0.129, 0.29, 0.677)	0.282
A_3	(-0.192, 0, 0.192)	0	(-0.192, 0, 0.192)	0	(-0.323, 0, 0.323)	0

Alternatives ranking by S,R,Q

	R	S	Q
A_1	3	3	3
A_2	2	2	2
A_3	1	1	1

TOPSIS

Linguistic variables
Linguistic variables Fuzzy Number

Very low	(0, 0.05, 015)
Low	(0.1, 02, 0.3)
Fairly low	(0.2, 0.35, 0.5)
Fair	(03, 05, 0.7)
Fairly good	(0.5, 0.65, 0.8)
Good	(0.7, 0.8, 0.9)
Very good	(0.85, 0.95, 1)

$\tilde{R} = [\tilde{r}_{ij}]mxn$ i = 1,2, …., m j = 1,2, …., n

Decision matrix

C_1

Criteria type	Positive
A_1	(0.15, 0.275, 0.4)
A_2	(0.45, 0.575, 0.7)
A_3	(0.675, 0.8, 0.9)

Criteria weights (1,1,1)

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right) \text{ for benefit}$$

$$c_j^* = max_i\, c_{ij}$$

$$r_{ij} = \left(\frac{a_j^0}{c_{ij}}, \frac{a_j^0}{b_{ij}}, \frac{a_j^0}{a_{ij}}\right)$$

$$a_j^0 = min_i\, a_{ij}$$

Normalized decision matrix

	C_1
A_1	(0.167, 0.306, 0.444)
A_2	(0.5, 0639, 0.778)
A_3	(0.75, 0.889, 1)

$\tilde{V} = [\tilde{v}_{ij}]_{mxn}$ i = 1,2, …., m j = 1,2, …., n

$$\tilde{v}_{ij} = \tilde{r}_{ij} \otimes \tilde{w}_j$$

Weighted normalized decision matrix

	C_1
A_1	(0.167, 0.306, 0.444)
A_2	(0.5, 0.639, 0.778)
A_3	(0.75, 0.889, 1)

$$v_j^* = (1,1,1)$$

$$v_j^- = (0,0,0)$$

$$\tilde{A} = (a_1, a_2, a_3)$$

$$\tilde{b} = (b_1, b_2, b_3)$$

$$(\tilde{A}, \tilde{B}) = \sqrt{\tfrac{1}{3}[(b_1 - a_1)^2 + (b_2 - a_2)^2 + (b_3 - a_3)^2]}$$

$d_i^* = \sum_{j=1}^{n} d(\tilde{v}_{ij} - \tilde{v}_j^*)$ i = 1,2, ….., n

$d_j^- = \sum_{j=1}^{n} d(\tilde{v}_{ij} - \tilde{v}_j^-)$ j = 1,2, ….., n

$Cc_i = \frac{d_i^-}{d_i^* + d_i^-}$ i = 1,2, ….., n

Alternatives ranking

Number	Alternatives	Distance from positive ideals	Distance from negative ideal	CC rank
1	A_1	0.704	0.326	0.3173
2	A_2	0.378	0.649	0.6322
3	A_3	0.158	0.886	0.8491

Conclusion:

On coming to the end of this paper, we have come across many methods and solutions and problems. We have come across fuzzy logic where many methods are being used like DEMATEL, AHP, ANP, VIKOR and TOPSIS. These methods shows various interpretations according to each tables and graphs which are mentioned in the above results. Every method has different way of approach to its own value of defined criteria according to the linguistic scales. Each method shows the high and low of the particular solution for the problem statement. Each are used wisely to obtain the results and the values obtained are elevated according to the result criteria. They are even mentioned in the graph. When compared with the results of AHP it shows the final weightages for the criteria manager which we taken as high with respect to the lowest to the worker. Here the manager dominates with the position. When taken for the TOPSIS results graph it clearly show that the third variable lies in the top order of the ranking scale and are obtained with respect to the other two alternatives. When taken on VIKOR method it clearly shows up the matrix order of all the variables which has different approach to the same problem.

In future, when it comes to the MCDM of any management system this paper is going to be a basic study for which all the results which we obtained and compared with all the DEMATEL, AHP, ANP, VIKOR and TOPSIS method, when it all comes to problem statement of decision making between the hierarchy of workforce and workplace this paper will be a basic. It is the beginning of the complex problem which has only limited number of variables but when it comesto more alternatives and criteria this can even be elaborated and referred with this paper.

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