Fuzzy Transportation Problem Using Vikor Risk Decision Making

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Abstract - The present paper further investigates the risk decision making tool with Fuzzy Transportation problem. Comparison of different fuzzy set ranking methods (required for processing fuzzy information) is performed. A complete sensitivity analysis concerning decision maker's risk preferences was carried out for three factors solutions identified. Then, a weights sensitivity analysis was performed on one of the three systems to see whether the rankings would change in response to changing weights.

Keywords - Transportation problem theory, fuzzy risk assessment , consistency ratio and index, Best non fuzzy approach value , risk decision making ,fuzzy utilities, Transportation costs, multi-criteria decision making.

I. INTRODUCTION

In real transportation problem situation a risk assessment features and analytical study with the problem that the information which necessary for constructing a calculation accuracy. So that the cost for getting this information seems too high, hence performance of risk features form constructing a decision making in the study and accuracy that this model is not an small process of the real problem. Fuzzy set theory offers the possibility to construct decision models with the vague decision models with vague data. Many risk models fuzzy components are proposed in literature, but only fuzzy utilities are important for practical application. When track to applied when the accuracy less combined to that numerical result small then the information cost. Therefore, the focus of this paper is concentrated on these subjects. It is shown that the principle of decision making can easily be extended to decision models with fuzzy risk utilities. Furthermore it is possible to use additional information in order to improve the prior probabilities. Moreover, fuzzy probabilities can be used combined with crisp utilities, described by real numbers, or fuzzy utilities. Apart from the fact that fuzzy models offer a more realistic modeling of decision situations, the proposed interactive solution process leads to a reduction of information costs. That circumstance is caused by the fact that additional information is gathered in correspondence with the requirements and under consideration of cost– benefit relations.

II. PRELIMINARIES

2.1 Definition: The average fuzzy numbers of the decision maker, which can be displayed by a trapezoidal fuzzy number as follows: $E_{ij} = (LE_{IJ} , ME_{IJ} , UE_{IJ})$ .The preceding endpoint values $(LE_{IJ} , ME_{IJ} , UE_{IJ})$ can be solved by the method put forward by buckley, that is,

$$LE_{ij^k} = \left(\sum_{k=1}^{m} LE_{ij^k}\right) \Big/ m$$

$$ME_{ij^k} = \left(\sum_{k=1}^{m} ME_{ij^k}\right) \Big/ m$$

$$UE_{ij^k} = \left(\sum_{k=1}^{m} UE_{ij^k}\right) \Big/ m \qquad (2.1)$$

2.2.Fuzzy systematic approach:

The weights of the each risk assessment factor of consyruxction project as well as they fuzzy possibility values must be integrated bythe calculation of fuzzy numbers so as to be located at the fuzzy synthetic approach value (effect value)of the integral assessment.according to the weight W derived by AHP weight vector can be obtained

$$LR_{ij} = \left(\sum_{k=1}^{m} LE_{ij^k}\right) * w_j$$

$$MR_{ij} = \left(\sum_{k=1}^{m} ME_{ij^k}\right) * w_j$$

$$UR_{ij} = \left(\sum_{k=1}^{m} UE_{ij^k}\right) * w_j \qquad (2.2)$$

2.3 Planning Transportation Problem

The problem here is to find a path which achieves some pre-defined purpose and is desirable (i.e., it is optimal or good in some way). Supplier evaluation and selection problem considered in here uses hypothetical data for five

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supplier alternatives. The percentage of Planning factors (scaled from 1 to 10) are given in table 1, Risk level of suppliers alternatives are evaluated by experts using linguistic variables, which are shown in below

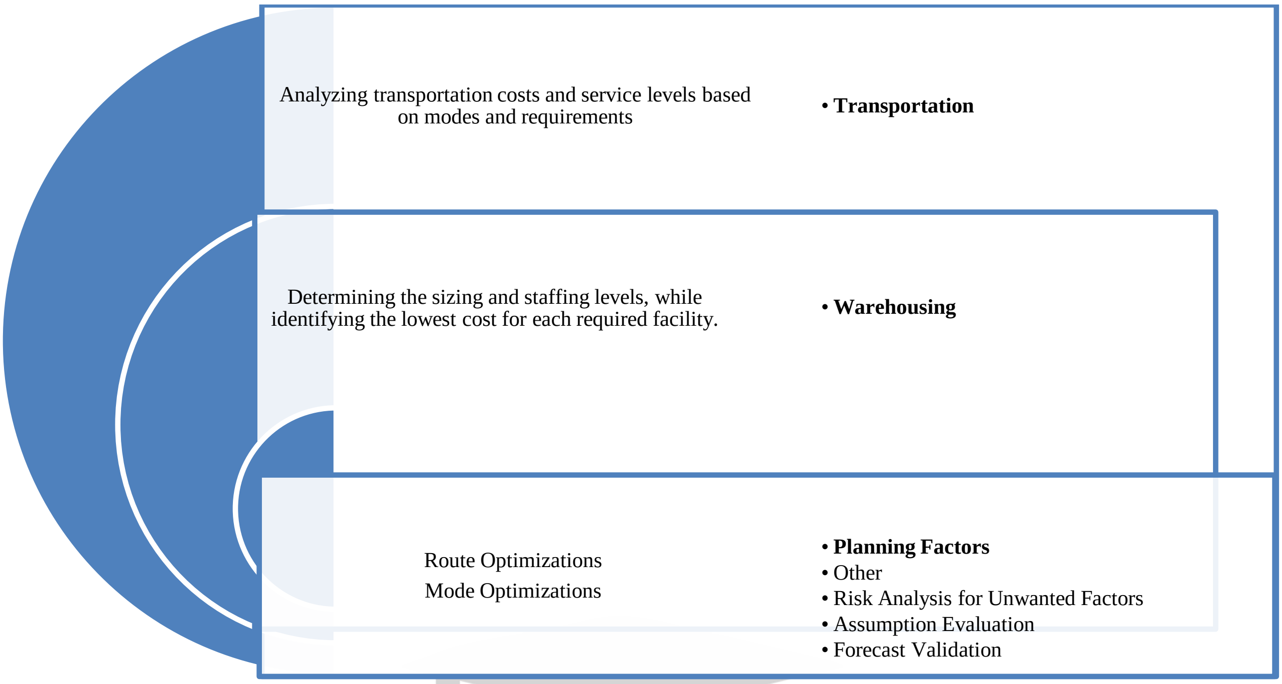

Figure 2.1 :Planning Transportation Problem

Table 2.1 : DATA FOR RISK RELATED TRANSPORTATION CRITERIA

Suppliers alternatives	Risk Analysis for Unwanted Factors	Mode Optimizations	Forecast Validation
1	(0.65,0.7,0.825,0.95)	[8.67,8,8.75,7.5]	[3.5,5.5,6.5,7]
2	(0.225,0.7,0.3,0.125)	[6.5,8.25,8.5,9.5]	[5,6.5,7.5,8.5]
3	(0.8,0.7,1,1)	[8,9,9,5,10]	[6,7.5,7.5,9.5]
4	(0.6,0.8,0.85,0.95)	[8.5,9,9.75,10]	[6,8,8,9.5]
5	(0.85,0.9,1,1)	[7,8.5,8.75,9.75]	[3,5,5,7]

The linguistic variables are quantified using a linguistic scale as follows [21]: very low VL (0, 1, 2), low L (2, 3, 4), medium M (4, 5, 6), high H (6, 7, 8), very high VH (8, 9,10). The risk assessments obtained from two experts are aggregated using the fuzzy average operator.A fuzzy linear regression model is built in a way to relate risk level of supplier alternatives to poor quality products rate, delayed products rate, and financial status. The resulting predicting equation using (2.2) with *H*= 0.5 is as follows:

Table2.2 : DATA RISK ASSESSMENTS FOR SUPPLIERS ALTERNATIVES

suppliers alternative	Risk level (Decision makers 1)	Risk level (Decision makers 2)	Risk level (Decision makers 3)
1	L	L	*L*
2	VL	*VL*	*H*
3	H	*H*	*M*
4	M	*VH*	*VH*
5	VH	M	*VL*

Table2.3 : PREDICTED RISK SCORE

Weight	A	L	M	U
(0.65,0.7,0.825,0.95)weight 0.625	1	0.75125	8.23	5.625
225,0.7,0.3,0.125)weight0.27	2	0.3375	8.18	6.875
(0.8,0.7,1,1)weight0.7	3	0.875	9.125	5.875
((0.6,0.8,0.85,0.95)weight0.64	4	0.8	9.3125	7.875
(0.85,0.9,1,1)weight0.75	5	0.9375	8.5	5
Total	3	3.70125	43.3475	31.25
Average	6	0.74025	8.6695	6.25

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III. RANKING THE FUZZY NUMBER

The result of the fuzzy synthetic approach reached by each activity is a fuzzy number. Therefore, it is necessary that a nonfuzzy ranking method for fuzzy numbers be used for during the project risk approach for each activity. To utilize the COA method BNA is a simple and practical method there is no neeed to bring in the preferrence of any evaluators, so it is used in this study in BNA Value of the fuzzy number R_{ij} can be found by the following equation .

Then the main interfaces of the system shown as below

$$\begin{pmatrix} F_{01} \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ F_{05} \end{pmatrix} \rightarrow \begin{pmatrix} W_1 \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ W_5 \end{pmatrix} \Leftrightarrow \begin{pmatrix} (L_1, M_1, U_1) \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ (L_5, M_5, U_5) \end{pmatrix} \rightarrow BNA$$

$$risk \rightarrow weights \Leftrightarrow possibility \rightarrow defuzzify$$

Table 3.1: PREDICTED RISK SCORE FUZZY TRANSPORTATION PROBLEM

$\frac{Distination}{Origin}$	Consolidations	Route Optimizations	Mode Optimizations	**Supply weight**
poor quality products rate	(0.65,0.7,0.825,0.95)	[8.67,8,8.75,7.5]	[3.5,5.5,6.5,7]	[3.5,5.5,6.5,7]=5.625
Delayed products rate	(0.225,0.7,0.3,0.125)	[6.5,8.25,8.5,9.5]	[5,6.5,7.5,8.5]	[5,6.5,7.5,8.5]=6.875
Financial status	(0.8,0.7,1,1)	[8,9,9,5,10]	[6,7.5,7.5,9.5]	[6,7.5,7.5,9.5]=7.625
Disorder	(0.6,0.8,0.85,0.95)	[8.5,9,9.75,10]	[6,8,8,9.5]	[6,8,8,9.5]=7.875
Regulation	(0.85,0.9,1,1)	[7,8.5,8.75,9.75]	[3,5,5,7]	[3,5,5,7]=5
Demand weight	[8.67,8,8.75,7.5]]=8.23	[6.5,8.25,8.5,9.5]=8.1875	[8,9,9.5,10]=9.125	Demand=25.5425 Supply=33 Unbalanced(+demand 7.4575)

Solution value 75.734 ,Hence D_2 is given precedence over D_1 and D_3, D_4 in that order.

Table 3.2: SCORE FUZZY TRANSPORTATION PROBLEM

$\frac{D}{O}$	**D1**	**D2**	**D3**	**Dummy**	**Supply weight**
O_1	$(\mathbf{0.65, 0.7}D\mathbf{, 0.825, 0.95})$	$[\mathbf{8.67, 8, 8.75, 7.5}]$	$[\mathbf{3.5, 5.5, 6.5, 7}]$	**(0,0,0,0)**	$[\mathbf{3.5, 5.5, 6.5, 7}]$**=5.625**
O_2	(0.225,0.7,0.3,0.125)= 0.3375	[6.5,8.25,8.5,9.5]=8.1875	[5,6.5,7.5,8.5]=6.875	(0,0,0,0)	[5,6.5,7.5,8.5]=6.875
O_3	(0.8,0.7,1,1)=0.875	[8,9,9,5,10]=9.125	[6,7.5,7.5,9.5]=7.625	(0,0,0,0)=0	[6,7.5,7.5,9.5]=7.625
O_4	(0.6,0.8,0.85,0.95)=0.8	[8.5,9,9.75,10]=7.0625	[6,8,8,9.5]=7.875	(0,0,0,0)=0	[6,8,8,9.5]=7.875
O_5	(0.85,0.9,1,1)=0.9375	[7,8.5,8.75,9.75]=8.5	[3,5,5,7 = 5]	(0,0,0,0)=0	[3,5,5,7]=5
Dem .weight	[8.67,8,8.75,7.5]]=8.23	[6.5,8.25,8.5,9.5]=8.1875	[8,9,9.5,10]=9.125	7.4575	Demand=25.5425 Supply=33 Unbalanced(+demand 7.4575)

Hence D_2 is given precedence over D_1 and D_3, D_4 in that order.

Table. 3.3.Price variability

Alternatives	Price increase
1	**8.19**
2	**9.13**
3	**7.88**
4	**8.5**
5	**9.13**

The predicted risk scores for alternatives are calculating using the fuzzy linear transportation equation. Table show then centre and spread values for the fuzzy risk scores.The suppliers and demand of the production and the percentage of price in creasee for short term are given in table respectively. In order to select the most appropriate supplier alternatives, a fuzzy transportaion model which aims minimizing the risk of suppliers and deman subject to the constraints and variablity is built. Hence , a decision makere can conclude the total cost from range 7.88 to 9.13, with it degree. Based on the above result may schedule the transportation and linear decision constraints.

IV. CONCLUSION

In this study, a group multiple criteria decision making methodology incorporating risk factors, is proposed. This approach, which uses fuzzy linear transportation to obtain a descriptive risk equation, enables managers to possess a mathematical expression of risk rather than a subjective evaluation. The most suitable supplier alternative is selected by solving a fuzzy linear programming transportation model. Future research will focus on applying the proposed approach to supplier , demand selection problems using real data. Various supplier, demand selection criteria and constraints can be added to real-world problems. Though there are many

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transportation problems that have been studied with different types of input data, this research has investigated the solutions of transportation problems in environment. The arithmetic operations on single valued trapezoidal numbers are employed to find the solutions. The solution procedures are illustrated with day-to-day problems. Though the proposed algorithms concretely analyze the solutions of decision making transportation problems, there are some limitations in predicting the solutions of qualitative and complex data. The computational complexity in handling higher dimensional problems will be overcome by transportation algorithm approach. In future, the research will be extended to deal with multiobjective solid transportation problems in environment.The researchers will be interested to overcome the abovestated limitations. Further, the approaches of transportation problems on fuzzy and intuitionistic fuzzy logic may be extended to neutrosophic logic.

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