Location Selection for Logistics Using an Integrated Critic-Ahp and Vikor Approach

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Abstract:

Energy-related increases in transportation costs have prompted governments to explore integrated transportation solutions in an effort to lower transportation expenses. The purpose of this research is to give recommendations for the geographical selection of logistics hubs where the most economical, quick, and safe transportation techniques will be identified, which will lead to a decrease in transportation costs. " Aegean and Central Anatolia were selected as the pilot zones for selecting the most optimal site for logistics facilities necessary to promote integrated transportation. A questionnaire survey gathered the data needed to make a site decision in these two areas, and the CRITIC-AHPVIKOR integrated technique was utilised to choose the best choice. The CRITIC-AHP approach was used to establish the weights of the criterion, however the VIKOR method was used to identify an alternate site.

INTRODUCTION:

In today's world, transportation and logistics are two of the most important factors influencing a country's economy. In order to lower transportation costs, reduce transportation sector dependence, and develop the logistics sector to interact with the energy and transportation sectors, it is critical to develop the logistics sector. Consequently, because transportation costs affect economies globally and because energy resources drive up transportation costs, countries have come up with coordinated transportation strategies aimed at cutting those costs. The term "supply chain" refers to all of the activities that take place between the point at which a commercial product is manufactured and the point at which it is consumed. The requirement of properly transporting this commodity to its ultimate destination is described by logistics supply. Taken as a whole, the logistics supply chain's applicability is critical, both in practise and in theory. The transportation sector is the most visible manifestation of the logistics industry in the field.

LITERATURE RESEARCH:

There are a slew of various theories out there on how to go about deciding on a warehouse or logistics site. Multi-criteria decision-making and integrative techniques take centre stage in these methods. For a chemical firm that serves consumers in the United States, Canel and Khumawala [1] undertook an assessment of eight prospective plant sites in the United States, South America, Europe, and the Far East. The centre of gravity and AHP approaches were employed by Chen [2] in the selection of storage areas. Studies like this one examine the region's sales volume, accessibility, land status, and other social, political, and intellectual capacities. As a subsection, Birsel and Cerit [3] looked at how the location of the logistics firms affects the land component, and the storage site selection issue was investigated. There is a strong emphasis on the role of land in the research. A fuzzy integral technique Choquet Integral was used by Demirel et al. [4] to evaluate four potential locations based on several criteria and their respective sub-criteria in a multicriteria decision making process. Multi-criteria decisionmaking strategies were examined by zcan et al. [5] for storage placement selection difficulties. Due to anticipated natural catastrophes or other occurrences, Zhang and his colleagues [6] performed a site selection assessment for facilities that may have been unavailable at a minimal cost and highest demand/coverage. Using an existing plant / customer cluster, Srivastava et al. [7] investigated the choice of a dynamic single-plant location and displacement issue in order to optimise cost and service performance. An effort was made by Ghadge et al. [8] using a case study to optimise the site of the single and double distribution centres. This research looked at a broader variety of site selection issues.

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METHODOLOGY:

A.Analytic Hierarchical Process (AHP) There has been a lot of discussion over the Analytical Hierarchy Process (AHP), which was created in 1965 by L. Thomas Saaty [9]. By comparing objective and subjective criteria in a second comparison, AHP identifies the relative relevance of each criterion and assigns a weight to it. The following are the first five AHP steps: The issue is presented, and the aim for the top of the hierarchy is established. Sub-criteria and alternatives are added to a list of objectives. Step 3: Create a comparison matrix with two columns for the purposes of comparing two variables. The weight vector has been discovered. To determine the consistency ratio, go to step 5. When it comes to consistency, the decision is made. The binary comparisons are re-examined and the procedure is repeated if there is no consistency. B. The CRITIC Approach According to Diakoulaki et al. [10], they established the CRITICAL approach based on SD, MW, and Correlation to weight the three assessment factors used to evaluate the performance of organisations. In the CRITICAL approach, the decision matrix is evaluated analytically and the assessment criteria are extracted. The CRITICAL Method's formula is as follows: First, the Decision Matrix is normalised Correlation Coefficient Matrix 2. Calculating the sum of all of the information related to the issue of contrast intensity and conflicts in assessment criteria Weighing criteria and determining their relative importance C. VIKOR Approach To handle multiple criterion decision issues, Serafim Opricovic and Tzeng employed the VIKOR approach initially presented by Opricovic. Based on alternatives and assessment criteria, a solution may be found in the method's foundation. There is no better answer than this far-reaching one[11]. Using a multi-criteria ranking index for the options, a near judgement may be made to the perfect answer under specific circumstances. The closest values are obtained by comparing the closeness values to the ideal alternative under the premise that each option is appraised based on decision-making criteria. The VIKOR technique has five steps: For each criterion, the best and worst values that the alternatives may take are established. The benchmark weights are determined by averaging the best and worst results for each choice. For each option or assessment unit, calculate the greatest benefit to the group. 4. The mean, lowest score, and maximum group benefit values are ranked from smallest to largest based on the results. It is advisable to go with the option that has the lowest group benefit value in this case. According to the order in Step 4, decision makers select acceptable benefits and acceptable sets of stability.

APPLICATION:

Surveys, load modelling, and statistical analyses were used as early research in developing the model for logistics site selection. There were 663 industrial and 161 logistics firms surveyed in 8 provinces in Central Anatolia and the Mediterranean area for the survey research. As a consequence of this research, 12 possible locations for the logistics site were identified. The AHP-CRITIC approach was used to input the geometric mean of the replies to the assessment criteria. Figure-1 depicts the logistics site selection hierarchy.

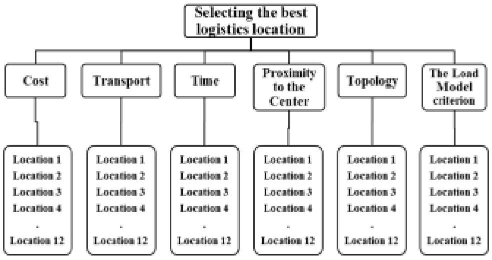

Figure 1. The hierarchical structure of the logistics location selection

The AHP-CRITIC approach was used to weight the criteria established by the expert panel, which would be taken into account alongside the load model criterion in the assessment of the different solutions. The following are the criteria and terminology used by the expert panel: How much it costs to move goods between different regions. The ratio of the average distance travelled by an individual to the average distance travelled by an individual. It is the distance-based transport density. The average time it takes to transport a cargo from one place to the next. The distance from the city centre to which the alternate corridor is linked. The distance between the closest railway station and the nearest corridor. Production/Shooting Balancing findings may be used as the Load Model criteria. The following are the criterion weights, as calculated by the AHP method: For each criteria, 663 firms were asked to make two comparisons using the following scale: 1/9 (Very minor), -1 (Equal), -9 (Very important). The geometric means of the binary comparison values acquired from these companies were then used to the AHP technique stages to create AHP weights. The following are the CRITIC weights: Weights for the CRITIC technique were calculated by applying CRITIC method steps on the decision matrix values Weights derived from the AHP-CRITIC approach have been multiplied and normalised. The AHP-CRITIC integrated method's priority values are shown in Table I. Table II provides the weighted criterion decision matrix used to assess the alternative areas acquired via the use of a geographic information system (GIS) and a load model, which will be used to determine the

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best alternative site using the VIKOR technique. The application for VIKOR was completed in accordance with the stages outlined by

TABLE II. DECISION MATRIX

CRITERIA →	Cost	Transport	Time	Proximity to the Center	Topology(km)	The Load Model criterion
Criteria Weights	0.21	0.17	0.12	0.04	0.02	0.44
ALTERNATIVES↓						
Afyonkarahisar OSB	727467,288	1,13436223	34938,44	7,5	1,4	756,1
Ankara 1. OSB	1098289,568	0,8855178	52353,064	28,3	29,4	1193,7
Ankara Anadolu OSB	804928,12	1,18794556	38094,072	41,4	51,7	905,8
Ankara Başkent OSB	938924,464	0,74388753	44805,688	42,7	53,9	1037,6
Denizli OSB	688161,968	0,57090069	33003,76	29,8	17	710,4
Eskişehir OSB	945762,664	2,51283452	45583,472	9	2,9	994,3
İzmir Atatürk OSB	1551914,696	2,88721439	73784,88	21,2	28,2	604,5
İzmir Kemalpaşa OSB	1517507,904	2,03617021	72299,456	26,9	31,7	385,4
Kayseri OSB	1502693,96	2,81227695	72521,104	15,6	12,2	175,1
Konya 1. OSB	616528,264	0,68235294	29225,96	6,8	8,7	661,8
Konya OSB	1159337,992	2,65586725	55653,024	17,9	19,9	1241,9
Manisa OSB	774011,784	1,24421053	37098,984	93,4	8,6	804,5

The solution was based on Opricovic and Tzeng [11], as well as the EXCEL application. Table III shows the cumulative maximum group benefits as a consequence of the VIKOR method process stages after criteria analysis and decision matrix formation. As a result, Eskişehir OSB is the best alternate site.

TABLE I. CRITERIA WEIGHTS

THE CRITERIA	AHP	CRITIC	AHP-CRITIC
Cost	0,21	0,16	0,21
Transport	0,11	0,25	0,17
Time	0,12	0,16	0,12
Proximity to the Center	0,04	0,14	0,04
Topology	0,02	0,15	0,02
The Load Model criterion	0,5	0,14	0,44
Consistency = 0.05 < 1			Total = 1.00

TABLE III. AVERAGE, WORST SCORE AND MAXIMUM GROUP BENEFIT VALUES OF REGIONS

Order	ALTERNATIVES↓	S(j)	R(j)	Q(j)
7	Afyonkarahisar OSB	0,37	0,200367454	0,280147881
4	Ankara 1. OSB	0,358	0,146909471	0,190254498
3	Ankara Anadolu OSB	0,365	0,138623922	0,184238075
5	Ankara Başkent OSB	0,392	0,157304067	0,237314953
8	Denizli OSB	0,432	0,219216348	0,365085789
1	Eskişehir OSB	0,249	0,102122235	0,024647129
10	İzmir Atatürk OSB	0,61	0,262894638	0,592157554
11	İzmir Kemalpaşa OSB	0,755	0,353262092	0,858480682
12	Kayseri OSB	0,769	0,44	1
9	Konya 1. OSB	0,404	0,239261342	0,368995345
2	Konya OSB	0,222	0,121864118	0,029214535
6	Manisa OSB	0,4	0,180404949	0,278633284

CONCLUSIONS:

In this research, a team of experts developed other routes for transporting freight, and a survey of the logistics sector was undertaken in each location. It was determined that the best site for logistics was determined after conducting an in-depth survey and doing load modelling based on data from both surveys. Multi Criteria Decision Making approaches, such as VIKOR, were utilised to choose the best alternative region. As a result of this method's inclusion of the closest proximity feature, it is recommended. Eskişehir, Konya, and Ankara Anadolu OSB are the ideal locations for a new logistics centre, according to the findings of the VIKOR technique. Using simply the transportation model in the selection of logistics regions might minimise the sensitivity, and it is difficult to incorporate data in terms of difficulties in collecting data in the logistics sector. As a logistic model, a multi-criteria model might be deceiving since it does not reflect the sector's present prospective load charts.

REFERENCES:

[1] Canel, C and Khumawala, B. M., "A mixed-integer programming approach for the international facilities location problem", International Journal of Operations & Production Management, 1996, 16(4) 49-68.

[2] Chen, C., "A Decision Model of Field Depot Location Based on the Centrobaric Method and Analytic Hierarchy Process (AHP)", International Journal of Business and Managament, 2009, vol.4 no.7 p. 71-75.

[3] Demirel T., Demirel, N Ç., Kahraman C., "Multi-Criteria Warehouse Location Selection Using Choquet İntegral", Expert Systems with Applications, 2010, vol. 37 p. 3943–3952

[4] Zhang, M, Huang, J Zhu, J M., "Reliable facility location problem considering facility failure scenarios", Kybernetes, 2012, 41(10) 1440- 1461.

[5] Srivastava, S. K., Amula, A. Ghagare, "Service facility relocation decision: a case study", Facilities, 2016, 34(9/10), 595-610.

[6] Ghadge, A. etc., "Facility location for a closed-loop distribution network: a hybrid approach", International Journal of Retail & Distribution Management,2016, 44(9) 884-902.

[7] Saaty, T L. "The Analytic Hierarchy Process" McGraw-Hill New York, 1980.

[8] Diakoulaki, D., Mavrotas, G., &Papayannakis, L. "Determining objective weights in multiple criteria problems: The critic method", Computers & Operations Research, 1995, 22(7), 763-770.

[9] S Opricovic and G H Tzeng, "Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS", European Journal of Operational Research, 2004, 156(2):445-455.

[10] Yang, J and Lee H., "An AHP decision model for facility location selection", Facilities, 1997, 15(9/10) 241-254.

[11] Korpela, J and Lehmusvaara, A, "A Customer Oriented Approach to Warehouse Network Evaluation and Design International", Journalof Production Economics vol., 1999 59 p. 135-146.

[12] Vlachopoulou, M, Silleos, G., Manthou, V., "Geographic Information Systems in Warehouse Site Selection Decisions",

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International Journal of Production Economics, 2001, vol. 71 issues 1–3 p. 205-212.

[13] Colson, G and Dorigo, F., "A Public Warehouses Selection Support System", European Journal of Operational Research, 2004, vol. 153 issue 2 p.332-349.

[14] Aktepe, A. and Ersöz, S., "AHP-VIKOR Ve MOORA Yöntemlerinin Depo YeriSeçimProblemindeUygulanması", EndüstriMühendisliğiDergisi, 2014, vol. 25 p.2-15.

[15] Kahraman, C., Ruan, D., Doğan, I.. "Fuzzy Group Decision-Making for Facility location Selection", Information Sciences, 2003, vol. 157 p. 135–153.

[16] Korpela, J and Tuominen M., "A Decision Aid in Warehouse Site Selection", International Journal of Production Economics, 1996, vol. 45 issues 1–3 p. 169-180.

[17] Yerlikaya, M. A. and Arıkan, F., "Constructing the performance effectiveness order of SME supports programmes via Promethee and Oreste techniques", Journal of the Faculty of Engineering and Architecture of Gazi University, 2016, vol. 31 p. 1007-1016.

[18] Sener, Z., "Evaluating Ship Selection Criteria for Maritime Transportation", Journal of Advanced Management Science 4(4), 2016, 325–328

[19] V. Tiwari, P. K. Jain, P. Tandon, "Product design concept evaluation using rough sets and VIKOR method" Advanced Engineering Informatics vol., 2016, 30 (1) pp. 16-25.

[20] A. A. Asthi and G. Kannan, "Green supplier development program selection using NGT and VIKOR under fuzzy environment", Computers and Industrial Engineering, 2016, vol. 91 pp. 100-108.

[21] P. Babashamsi, A. Golzadfar, N. Yusoff, H. Ceylan, N. Nor, "Integrated fuzzy analytic hierarchy process and VIKOR method in the prioritization of pavement maintenance activities", International Journal of Pavement Research and Technology, 2016, vol. 9 (2) pp. 112-120.

[22] H. Gupta, "Evaluating service quality of airline industry using hybrid best worst method and VIKOR", Journal of Air Transport Management, 2017, pp. 1-13.

[23] Özcan, T., Çelebi N., Esnaf Ş., "Comparative Analysis of Multi Criteria Decision Making Methodologies and Implementation of a Warehouse Location Selection Problem", Expert Systems with Applications, 2011, vol. 38 p. 9773–9779.

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