SETSCI Conference Proceedings
11, 36-38, 2019

4th International Symposium on Innovative Approaches in Social, Human and Administrative Sciences

November 22-24, 2019, Samsun, Turkey

https://doi.org/10.36287/setsci.4.8.006

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ISAS WINTER - 2019

Third-Party Logistics Provider Selection By Using AHP and CODAS Methods

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Presentation/Paper Type: Oral / Full Paper

Abstract – Companies would like to gain a competitive advantage in today's world where global competition is intense by focusing on their main activities. Therefore, most of the companies use outsourcing for their logistics activities. Third-party logistics providers are outsourcing organizations that perform some or all of the logistics activities of companies. In order for the logistics activities to continue accurately in the medium and long term, companies need to establish a strategic partnership with a good third-party logistics provider. To achieve this goal, companies should identify the best third-party logistics provider. Many factors and alternatives need to be considered in the problem of selecting third-party logistics providers. Therefore, this problem can be called a multi-criteria decision-making (MCDM) problem. In this study, third-party logistics provider selection will be made for a textile company with the Analytic Hierarchy Process (AHP) and Combinative Distance-Based Assessment (CODAS) methods. In this study, four alternatives were evaluated with respect to six criteria.

Keywords *– Third-party logistics provider, AHP, CODAS, MCDM, Logistics.*

I. INTRODUCTION

Companies attempt to gain competitive advantage in today's world where global competition is intense. Companies need to focus on their core activities in achieving a competitive advantage. Therefore, most of the companies outsource their non-core activities, such as logistics. Third-party logistics providers are contracting organizations carrying out some or all of the company's logistics operations.

In order to continue the logistics operations effectively in the medium and long term, companies need to develop a strategic partnership with a good third-party logistics provider. Companies should determine the best third-party logistics provider to achieve this goal. Many factors and alternatives need to be considered in the problem of selecting third-party logistics providers. Thus, this problem can be called a multi-criteria decision-making (MCDM) problem. In this study, an integrated MCDM model including AHP and CODAS is used to identify the best third-party logistics provider for a textile company. The next section will indicate literature review.

II. LITERATURE REVIEW

The articles regarding the selection of third-party logistics providers in recent years are shown in Table 1.

Table 1. Literature Review

Authors	**Methods**	**Year**
Sremac et al. [1]	SWARA-WASPAS	2018
Zarbakhshnia et al. [2]	SWARA-COPRAS	2018
Singh et al. [3]	AHP-TOPSIS	2018
Pamucar et al. [4]	BWM-WASPAS-MABAC	2019
Govindan et al. [5]	ELECTRE I- SMAA	2019
Ayçin [6]	DEMATEL	2019

III. METHODOLOGY

In this study, AHP and CODAS methods will be used to address third-party logistics provider selection problem.

A. AHP

The steps of AHP [7] are indicated as follows [8].

Step 1: The pairwise comparison matrix (C) is constructed by using a 1 to 9 scale.

$$C = [c_{ij}]_{n\times n} \quad (1)$$

Step 2: This matrix is normalized by equation 2. Then the weights of criteria (w_j) are calculated by equation 3.

$$c'_{ij} = \frac{c_{ij}}{\sum_{i=1}^{n} c_{ij}} \quad (2)$$

$$w_j = \frac{\sum_{j=1}^{n} c'_{ij}}{n} \quad (3)$$

Step 3: Consistency Index (CI) and Consistency Ratio (CR) of the matrix are computed as [9].

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (4)$$

$$CR = \frac{CI}{RI} \quad (5)$$

B. CODAS

The steps of CODAS are indicated as follows [10].

Step 1: Decision matrix is constructed by using a 1 (very low) to 9 (very high) scale.

$$E = [e_{ij}]_{m\times n} \quad (6)$$

Step 2: Values in the matrix are normalized.

$$e'_{ij} = \frac{e_{ij}}{max(e_{ij})} \quad \text{(for beneficial criteria)} \quad (7)$$

$$e'_{ij} = \frac{min(e_{ij})}{e_{ij}} \quad \text{(for non-beneficial criteria)} \qquad (8)$$

Step 3: Weights are multiplied with normalized values.

$$e^*_{ij} = e'_{ij} w_j \qquad (9)$$

Step 4: Negative ideal solution (ns_j) is obtained for each criterion.

$$ns_j = \min(e^*_{ij}) \qquad (10)$$

Step 5: Euclidean (P_i) and Taxicab (T_i) distances are calculated as.

$$P_i = \sqrt{\sum_{j=1}^{n} (e^*_{ij} - ns_j)^2} \qquad (11)$$

$$T_i = \sum_{j=1}^{n} \left| e^*_{ij} - ns_j \right| \qquad (12)$$

Step 6: Relative assessment matrix (R_a) is computed as.

$$R_a = [h_{ik}]_{m \times m} \qquad (13)$$

$$h_{ik} = (P_i - P_k) + (\omega(P_i - P_k) \times (T_i - T_k)) \quad (14)$$

$$\omega(x) = \begin{cases} 0, & |x| < \nabla \\ 1, & |x| \geq \nabla \end{cases} \qquad (15)$$

In equation 15, $\omega(x)$ is a threshold function and ∇ is the threshold parameter. This parameter is taken as 0,02 in this study.

Step 7: The last score (S_i) for each alternative is computed as.

$$S_i = \sum_{k=1}^{n} h_{ik} \qquad (16)$$

IV. APPLICATION

The best third-party logistics provider is chosen for a textile company in this study. All data used in this study were obtained from the distribution manager of the company. In this study, four alternatives are evaluated under six criteria. Only one criterion (transportation cost) is non-beneficial criterion and others are beneficial criteria. Table 2 indicates the pairwise comparison matrix.

Table 2: The Pairwise Comparison Matrix

Criteria \ Criteria	Delivery	Reliability	Transportation Cost (TC)
Delivery	1	2	0,5
Reliability	0,5	1	0,333
Transportation Cost (TC)	2	3	1
Reputation	0,333	0,5	0,5
Services	0,25	0,25	0,333
Flexibility	0,2	0,2	0,2
Criteria \ Criteria	**Reputation**	**Services**	**Flexibility**
Delivery	3	4	5
Reliability	2	4	5
Transportation Cost (TC)	2	3	5
Reputation	1	1	2
Services	1	1	5
Flexibility	0,5	0,2	1

The weights of criteria are obtained using AHP. These weights are indicated in Table 3.

Table 3: The Weights of Criteria

Criteria	Weights
Delivery	0,255
Reliability	0,185
TC	0,317
Reputation	0,099
Services	0,101
Flexibility	0,043
CR	0,071

After obtaining the weights of criteria, decision matrix, which is indicated in Table 4, is constructed.

Table 4: Decision Matrix

Alternatives \ Criteria	Delivery	Reliability	TC
Al1	5	8	6
Al2	7	6	8
Al3	6	6	6
Al4	7	6	6
Alternatives \ Criteria	**Reputation**	**Services**	**Flexibility**
Al1	5	6	6
Al2	7	7	8
Al3	6	6	7
Al4	4	4	6

Equations 7-8 are used to normalize this matrix. Normalized decision matrix is indicated in Table 5.

Table 5: Normalized Decision Matrix

Alternatives \ Criteria	Delivery	Reliability	TC
Al1	0,714	1	1
Al2	1	0,75	0,75
Al3	0,857	0,75	1
Al4	1	0,75	1
Alternatives \ Criteria	**Reputation**	**Services**	**Flexibility**
Al1	0,714	0,857	0,75
Al2	1	1	1
Al3	0,857	0,857	0,875
Al4	0,571	0,571	0,75

The results of equations 9-12 are indicated in Table 6.

Table 6: Weighted Normalized Decision Matrix

Alternatives \ Criteria	Delivery	Reliability	TC	P_i
Al1	0,182	0,185	0,317	0,097
Al2	0,255	0,139	0,238	0,095
Al3	0,219	0,139	0,317	0,096
Al4	0,255	0,139	0,317	0,108
ns_j	0,182	0,139	0,238	
Alternatives \ Criteria	**Reputation**	**Services**	**Flexibility**	T_i
Al1	0,071	0,087	0,032	0,168

Al2	0,099	0,101	0,043	0,169
Al3	0,085	0,087	0,038	0,179
Al4	0,057	0,058	0,032	0,152
ns_j	0,057	0,058	0,032	

Relative assessment matrix is computed by using equations 13-15. This matrix is indicated in Table 7.

Table 7: Relative Assessment Matrix

Alternatives \ Alternatives	**Al1**	**Al2**
Al1	0	0,002
Al2	-0,002	0
Al3	-0,001	0,001
Al4	0,011	0,013
Alternatives \ Alternatives	**Al3**	**Al4**
Al1	0,001	-0,011
Al2	-0,001	-0,013
Al3	0	-0,012
Al4	0,012	0

The last score (S_i) for each alternative is calculated by using equation 16. Scores of alternatives and rankings of alternatives are indicated in Table 8.

Table 8: The Results of CODAS

Alternatives \ Results	S_i	**Rankings**
Al1	-0,008	2
Al2	-0,016	4
Al3	-0,012	3
Al4	0,036	1

V. CONCLUSION

In this study, an integrated MCDM model including AHP and CODAS is proposed to determine the best third-party logistics provider for a textile company. According to the results of the integrated model, the order of alternatives are as follows; Al 4 > Al 1> Al 3> Al 2. Future research may use different MCDM models to solve the same problem.

REFERENCES

[1] S. Sremac, Ž. Stević, D. Pamučar, M. Arsić, and B. Matić, "Evaluation of a third-party logistics (3PL) provider using a rough SWARA–WASPAS model based on a new rough dombi aggregator," *Symmetry*, vol. 10, no.8, 305, 2018.

[2] N. Zarbakhshnia, H. Soleimani, and H. Ghaderi, "Sustainable third-party reverse logistics provider evaluation and selection using fuzzy SWARA and developed fuzzy COPRAS in the presence of risk criteria," *Applied Soft Computing*, vol. 65, pp. 307-319, 2018.

[3] R. K. Singh, A. Gunasekaran, and P. Kumar, "Third party logistics (3PL) selection for cold chain management: a fuzzy AHP and fuzzy TOPSIS approach," *Annals of Operations Research*, vol. 267, no. (1-2), pp. 531-553, 2018.

[4] D. Pamucar, K. Chatterjee, and E. K. Zavadskas, "Assessment of third-party logistics provider using multi-criteria decision-making approach based on interval rough numbers," *Computers & Industrial Engineering*, vol. 127, pp. 383-407, 2019.

[5] K. Govindan, M. Kadziński, R. Ehling, and G. Miebs, "Selection of a sustainable third-party reverse logistics provider based on the robustness analysis of an outranking graph kernel conducted with ELECTRE I and SMAA," *Omega*, vol. 85, pp. 1-15, 2019.

[6] E. Ayçin, "Üçüncü Parti Lojistik Hizmet Sağlayıcı Seçim Kriterlerinin Gri DEMATEL Bütünleşik Yaklaşımıyla Belirlenmesi," *Alphanumeric Journal*, vol. 6, no.2, pp. 277-292, 2019.

[7] T. L. Saaty, "A Scaling Method for Priorities in Hierarchical Structures," *Journal of Mathematical Psychology*, vol. 15, pp. 234-281, 1977.

[8] A. Özbek, and T. Eren, "Üçüncü Parti Lojistik (3PL) Firmanın Analitik Hiyerarşi Süreciyle (AHS) Belirlenmesi," *Uluslararası Mühendislik Araştırma ve Geliştirme Dergisi*, vol. 5, pp. 12-20, 2013.

[9] T. L. Saaty, "How to Make a Decision: The Analytic Hierarchy Process," *Interfaces*, vol. 24, pp.19-43, 1994.

[10] M. Keshavarz Ghorabaee, E. K. Zavadskas, Z. Turskis, and J. Antucheviciene, "A New Combinative Distance-Based Assessment (Codas) Method For Multi-Criteria Decision-Making," *Economic Computation & Economic Cybernetics Studies & Research*, vol. 50, pp. 25-44, 2016.