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Research Article

Comparative Performance Evaluation & Ranking of Clearing and Forwarding Agent Companies: A Combined AHP & VIKOR Analysis

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Abstract

Logistics Improvements are dominated by Globalization, advancements, computer technology, and increased internet access in the twenty-first century. The state of the logistics industry is evolving. Without logistical planning, any manufacturing or a marketing operation will be difficult to complete. A Clearing & Forwarding Agent is a person who is engaged in providing any service, either directly or indirectly, that is associated with clearing and forwarding activities in any manner to another person. This study uses VIKOR Analysis to analyze the performance of ten clearing and forwarding logistics service providers over five-year period from 2014 to 2019 and award a Rank based on their scores. The results revealed that 5 Way Logistics proved to be the most dominant company among other alternatives over the study period.

Key Words: MCDM, AHP, VIKOR

INTRODUCTION

Logistics is thought to have evolved when a society has progressed from a state of human self-sufficiency to the requirement for an exchange in the socioeconomic system. Prior to the 1950s, there was no idea of logistics, yet logistical duties were performed without an appropriate acknowledgment in the business sector. Though it has been an integral part of Marketing, Finance, Production and Personnel since the Industrial Revolution, it is a recent addition in the jargon of Integrated Business Management. Logistics Improvements are dominated by Globalization, advancements, computer technology, and increased internet access in the twenty-first century. The state of the logistics industry is evolving. The year ahead appears to be one in which warehouses and distribution centers continue to develop and adopt technology-based operations. Shippers can operate smarter, faster, and with fewer people.

It's all about getting things or services to where they're needed and when they're needed. Without logistical planning, any manufacturing or a marketing operation will be difficult to complete. As a result, logistics entail coordinated warehousing, transportation, packaging, and inventory control initiatives. Logistics management follows a set of procedures to carry out its duties. A Clearing & Forwarding Agent is a person who is engaged in providing any service, either directly or indirectly, that is associated with clearing and forwarding activities in any manner to another person. An individual can act as C&F agent only if he holds a customs license. The license is issued by the customs authorities on clearing the examination conducted. The license may be a temporary license or a regular license. This study uses VIKOR Analysis to analyze the performance of ten clearing and forwarding logistics service providers over five-year period from 2014 to 2019 and award a Rank based on their scores.

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PROBLEM STATEMENT:
The purpose of this research is to evaluate and rank the Performance of Clearing and Forwarding Agent Companies, a type of logistics service providing company by using the Multi Criteria Decision Making Techniques (MCDM) such as Analytic Hierarchy Process (AHP) and Visekriterijumska Optimizacija I Kompromisno Resenje (VIKOR).

OBJECTIVES OF THE STUDY:
 ➢ To measure the performance of 10 Clearing and Forwarding Agent Companies in Chennai.
 ➢ To evaluate and rank Clearing and Forwarding Agent Companies based on five variables namely Total Transportation cost, C&F Expenses, Warehouse Rent, Service Charges received and Brokerage received.
 ➢ To compare the performance of Clearing and Forwarding Agent Companies under the study.

LITERATURE REVIEW
The main objective of this paper is to present a systematic review of various kinds of MCDM techniques like AHP, VIKOR and TOPSIS on the basis of their preferences towards their respective applicableness.

Prashant Kumar Singh & P Sarkar (2019) in their article, "A Framework based on Fuzzy AHP-TOPSIS for Prioritizing Solutions to overcome the barriers in the implementation of Eco-Design Practices in SMEs" implemented AHP and TOPSIS and found that MCDM provided an effective support in the decision-making of the company for producing eco-friendly products through the implementation of eco-design practices.

Masaki Yumoto(2019), in the research article, " Development of Decision Support system for Product based on AHP using the decision rule of rough set for Qualitative Evaluation" proposed AHP on several samples to make decision rules based on the target user's judgment of Good or Bad in the qualitative evaluation criterion.

Mustafa Yurdakul & Yusuf Tansel (2019) in their research paper "Comparison of Fuzzy and Crisp Versions of an AHP and TOPSIS Model for Nontraditional Manufacturing Process Ranking Decision", used AHP & TOPSIS Model to replace crisp (non-fuzzy) versions of the AHP and TOPSIS with the fuzzy ones.

Samanlioglu Funda & Ayag Zeki(2019), in their research paper "A Fuzzy AHP-VIKOR Approach for Evaluation of Educational use Simulation Software Packages", proposed fuzzy AHP-VIKOR to help educators select the best software package.

Venkatesh (2019) in his Research paper, "To Rank Supply Partner Selection in Continuous aid Humanitarian Supply Chain" proposed fuzzy AHP and fuzzy TOPSIS to select the best supply partner effectively

Xia Wang & Qingquan Duan (2019), in their article "Improved AHP-TOPSIS Model for the Comprehensive Risk Evaluation of Oil and Gas Pipelines" used AHP and TOPSIS to identify potential hazards in time and founds that the results based on improved AHP – TOPSIS is valuable and feasible.

Rohit Kumar Singh & Surendra Kansara(2018) in their article "Vendor Rating system for an Indian Start-Up: A Combined AHP & TOPSIS Approach" used TOPSIS to identify the criteria that are used for vendor or supplier rating, based on the industry inputs and develop a vendor rating model and found that the research brought forward the criteria that are useful for rating vendors or suppliers with reference to 3DP sector

Rajesh Kr. Singh, Angappa Gunasekaran & Pravin Kumar(2018), in their article "Third Party Logistics (3PL) Selection for Cold Chain Management: A Fuzzy AHP and Fuzzy TOPSIS Approach" proposed fuzzy AHP and Fuzzy TOPSIS to outsource the logistics activities of perishable products. The results implied that logistic providers should focus on practices such as automation of processes and innovation in cold chain processes to become more competitive.

Balram Dey, Bipradas Bairagi, Bijan Sarkar & Subir Kumar Sanyal(2016) in their article, "Multi Objective Performance Analysis: A Novel Multi-Criteria Decision Making Approach for a Supply Chain" proposed Multi Objective Performance Analysis to solve decision problems in supply chain. The analysis showed that the results perfectly match with most of the cited decision problems of previous research works.

Hasan Dincer & Umit Hacioglu(2015) in their article, "A Comparative Performance Evaluation on Bipolar Risks in Emerging Capital Matkets Using Fuzzy AHP-TOPSIS and VIKOR Approaches" used fuzzy AHP – TOPSIS and fuzzy AHP – VIKOR to analyze the financial conflict risk-based performance levels of selected emerging economies. The overall performance of each method demonstrates that both methods give coherent results in ranking the seven determinants under the fuzzy environment.

RESEARCH METHODOLOGY:

The study is based on Secondary Data using Convenient Sampling Method in which, Ten Clearing & Forwarding Agent Companies were chosen and studied for a period of 5 years from 2014-2019.

List of Clearing & Forwarding Agent Companies under Study

Homan Logistics, Sea Hawk Logistics, Easy Way Logistics, Global Shipping, Caravel Shipping Services, 5Way Logistics Solutions, Skyline Shipping & Logistics, Worldwide Logistics, Eagle Freight Logistics, SSS Clearing and Forwarding Private Limited.

TOOLS USED FOR ANALYSIS:

Multi Criteria Decision Making Techniques for Evaluation and Ranking:

The Multiple Criteria Decision Making (MCDM) can be generally described as the process of selecting one from a set of available alternatives, or ranking alternatives, based on a set of criteria, which usually have a different significance. AHP is one of Multi Criteria decision making method that was originally developed by Prof. Thomas L. Saaty.

Analytic Hierarchy Process & VIKOR Analysis

In this study, AHP has been used to assign weights to all 5 variables, which serves as the base for calculating VIKOR analysis. VIKOR analysis has been used to rank the variables and compare the company's performance.

LIMITATIONS OF STUDY:

➢ The study is conducted for only 10 Clearing and Forwarding Agent Companies.
➢ Statistical Tools have its limitations.

SCOPE OF THE STUDY:

This study has been undertaken among companies for the period 2014-2019. Further the study can be extended to other logistics companies which include Transportation, Packaging, and Warehousing etc.

RESULTS & DISCUSSION:

PROCESS OF AHP:

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The AHP encompasses six basic steps as summarized as follows:

Step 1: AHP uses several small sub problems to present a complex decision problem.
Step 2: The decision matrix, which is based on SAATY'S nine-point scale, is constructed. The decision maker uses the fundamental 1–9 scale defined by SAATY to assess the priority score. Table 1 shows SATTY'S Scale of Relative Importance.

Table 1: SATTY'S SCALE

Scales	Assessment
1	Equally Important
3	A Little Important
5	Obviously Important
7	Very Important
9	Extremely Important
2,4,6,8	The Compromise between the two Scale
Multiplicative inverse	$aji = 1/aij$

Table 2: Random Indices

1	2	3	4	5	6	7	8	9	10
0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Step3: It involves the comparison in pairs of the elements of the constructed hierarchy. The alternative with the highest weight coefficient value should be taken as the best alternative.
Step4: AHP also calculates an inconsistency index (or consistency ratio) to reflect the consistency of decision maker's judgments during the evaluation phase. The inconsistency index in both the decision matrix and in pairwise comparison matrices could be calculated with the equation, $CI = (max - n)/(n - 1)$. The closer the inconsistency index is to zero, the greater the consistency.
Step5: The comparison matrix has to be normalized before all the calculations of vector of priorities.
Step6: The eigenvalues of the matrix are to be calculated which would give the relative weights of criteria.

VIKOR ANALYSIS:
VIKOR method is a multi-criteria decision making (MCDM) developed by Serafim-Opricovic to solve decision problems with conflicting and non-commensurable (different units) criteria. VIKOR ranks alternatives and determines the solution named compromise that is the closest to the ideal. The multi-criteria measure for compromise ranking is developed from the LP-metric used as an aggregating function in a compromise programming method.

PROCESS OF VIKOR:
Step 1: Establish a matrix of criteria and different alternatives.
Step 2: Normalize the decision matrix.
Step 3: Calculate the weight of the normalized decision matrix.
Step 4: Determine the positive and negative ideal solutions.
Step 5: Compute the distance for each alternative.
Step 6: Calculate the relative closeness to the ideal solution.

Step 7: Rank the preference order.

ANALYTIC HIERARCHY PROCESS:

Analytic Hierarchy Process (AHP) has been used to assign weights to all the variables in order to rank the company. Pair wise comparison matrix is developed for all the 5 variables under the study. Consistency Ratio (CR) is generally calculated to know the consistency level of weights and is compared with RI (RANDOM INDEX). If CR is less than 0.10, then only the analysis can proceed further. The weighted result of AHP is shown in the table. Following are the steps involved in the calculation of weights.

The best fi and the worst fi values of all criterion functions are determined. The values Sj and Rj are computed. Then the Qj values are computed. The values Si, Ri & Qi are sorted from the minimum value and the alternatives are ranked. The entire process of AHP and VIKOR is repeated for a period of five years from 2014-2015 to 2018-2019 for all C&F Companies. It specifically analyses and ranks all the Clearing and Forwarding agent companies in Chennai for the past five years based on 5 factors such as total Transportation Cost, C&F Expenses, Warehouse Rent, Service charges received and Brokerage received.

CALCULATION OF WEIGHTS FOR CRITERIA

Table 3: Normalized Pair Wise Matrix

	TC	C&F Exp	WR	SCR	BR	Criteria Weights
TC	0.5291	0.5862	0.6319	0.5945	0.1579	0.4999
C & F Exp	0.1058	0.1172	0.0789	0.1982	0.2632	0.1527
WR	0.1323	0.2345	0.1579	0.1321	0.1579	0.1629
SC	0.0582	0.0387	0.0789	0.0661	0.3684	0.1221
BR	0.1746	0.0234	0.0521	0.0092	0.0526	0.0624

Source: Computed

In the above Table TC denotes Transportation Cost, C&F Exp denoted Clearing & Forwarding Expenses, WR represents Warehouse Rent, SCR denotes Service Charges Received and BR represents Brokerage received.

A Pair Wise Comparison Matrix is created with the help of scale of relative importance. Then a Normalized Pair Wise is obtained by dividing the value of each cells by respective sum of criteria followed by obtaining criteria weights by averaging all the elements in row and dividing the same by number of criteria.

Table 4: Ratio of Weighted Sum Value to Criteria Weights

Weighted Sum Value	Criteria Weights	Calculation
3.2011	0.4999	6.4035
1.0124	0.1527	6.6299
1.0246	0.1629	6.2897
0.7457	0.1221	6.1073
0.3287	0.0624	5.2676

Source: Computed

The above Table 4 depicts the Ratio of Weighted Sum Value to Criteria Weights. Weighted Sum Value is

obtained by using the pair wise comparison matrix which is not normalized. Further the value of the cells in the matrix are multiplied with the criteria weights, where the values are again added in row wise to get the weighted sum value.

Table 5: Calculation of Consistency Index & Consistency Ratio

LAMBDA MAX	6.1396
Consistency Index	0.2849
Consistency Ratio	0.10

Source: Computed

The above Table 5 shows the calculation of LAMBDA MAX, Consistency Index and Consistency Ratio.

Table 6: Finalized Weights

Variables	Weightage
Transportation Cost	0.4999
Clearing & Forwarding Expenses	0.1527
Warehouse Rent	0.1629
Service Charges Received	0.1221
Brokerage Received	0.0624

Source: Computed

The above table shows the finalized weightage obtained which is being further utilized by VIKOR Method for the periods from 2014 – 2015 to 2018 – 2019 to rank the performance of Clearing and Forwarding Agent Companies.

VIKOR analysis helps to select the best alternative and rank them. It helps in solving the complex problem which leads to the final decision. In the present study, decision matrix was taken as the original data which was again normalized using the weights obtained under the AHP method. This process is repeated for five years from 2014-2015 to 2018- 2019 for all 10 Clearing and Forwarding Agent Companies.

Ranking of Clearing & Forwarding Agent Companies

The Analysis of each yearis given in Two Parts:
Part-1: Finding Best & Worst value for each Criterion & The Weighted Normalized Matrix
Best: $(X_{ij})_{max}$ for beneficial, $(X_{ij})_{min}$ for non-beneficial
Worst: $(X_{ij})_{min}$ for beneficial, $(X_{ij})_{max}$ for non- beneficial

Part-2: Value of Utility Measure (Si), Regret Measure (Ri), Value of VIKOR Index (Qi) and Rank.

Table 7a: Beneficial & Non- Beneficial Criteria Results (2014 – 2015)

Particulars	TC	C&F Exp	WR	SCR	BR
Criteria	Non Beneficial	Non Beneficial	Non Beneficial	Beneficial	Beneficial
Weightage	0.4999	0.1527	0.1629	0.1221	0.0624
BEST VALUE (Xi^+)	6,00,000	3,80,000	2,00,000	34,79,810	7,25,000
WORST VALUE (Xi^-)	30,00,000	15,26,314	7,00,000	4,56,000	38,893

Source: Computed

Table 7b: Value of Weighted Normalized Matrix

DMU	TC	C&F Exp	WR	SCR	BR
HL	0.0372	0.0062	0	0.0798	0.0608
SWL	0.2608	0.0964	0.0933	0.0164	0.0158
EWL	0	0	0.0314	0.1221	0.0624
GS	0.0283	0.0135	0.0309	0.0909	0.059
CSS	0.03	0.0085	0.0553	0.0800	0.0577
5WLS	0.0254	0.0113	0.0004	0.0814	0.0592
SSS	0.4999	0.151	0.1369	0	0.0019
WL	0.3966	0.1527	0.1629	0.0467	0.0215
EFL	0.3604	0.1437	0.1557	0.0192	0.001
SSS C&F	0.3604	0.085	0.1381	0.1188	0

Source: Computed

Table 7c: Si, Ri, Qi Values & Rank (2014 – 2015)

DMU	Si	Ri	Qi	Rank
HL	0.117	0.0798	0.0051	2
SWL	0.2772	0.2608	0.4646	6
EWL	0.1221	0.1221	0.0815	5
GS	0.1192	0.0909	0.0499	4
CSS	0.11	0.08	0.0441	3
5WLS	0.1068	0.0814	0.0019	1
SSS	0.4999	0.4999	1	10
WL	0.4433	0.3966	0.8695	9
EFL	0.3796	0.3604	0.7444	7
SSS C&F	0.4792	0.3604	0.7625	8

Source: Computed

The above Table 7a shows the results of Beneficial & Non-Beneficial Criteria for the 5 variables, Transportation Cost (TC), Clearing & Forwarding Expenses (C&F Exp), Warehouse Rent (WR), Service Charges Received (SCR) and Brokerage received(BR) of the 10 Companies, Homan Logistics, Sea Hawk Logistics, Easy Way Logistics, Global Shipping, Caravel Shipping & Services, 5Way Logistics Solutions, Skyline Shipping & Logistics, Worldwide Logistics, Eagle Freight Logistics and SSS Clearing & Forwarding. Table 7b depicts the Values of Weighted Normalized Matrix. Table 7c gives the Si, Ri, Qi Values along with the rank during the year 2014 - 2015 by the companies chosen for the study. It shows that in both utility and regret measures, 5Way logistics solutions is the best alternative having the lowest index value of 0 and the most dominant company among other alternatives. After calculating utility and regret measures, VIKOR index (Qi) is calculated for the optimal solution. The alternative DMUs are ranked using VIKOR index.

Table 8: Si, Ri, Qi Values & Rank (2015 – 2016)

DMU	Si	Ri	Qi	Rank
HL	0.117	0.0798	0.0051	2

SWL	0.2772	0.2608	0.4646	6
EWL	0.1221	0.1221	0.0815	5
GS	0.1192	0.0909	0.0499	4
CSS	0.11	0.08	0.0441	3
5WLS	0.1068	0.0814	0.0019	1
SSS	0.4999	0.4999	1	10
WL	0.4433	0.3966	0.8695	9
EFL	0.3796	0.3604	0.7444	7
SSS C&F	0.4792	0.3604	0.7625	8

Source: Computed

The above Table 8 states that in both utility and regret measures, 5Way logistics solutions is the best alternative having the lowest index value of 0 and the most dominant company among other alternatives during the year 2015-2016. After calculating utility and regret measures, VIKOR index (Q_i) is calculated for the optimal solution. The alternative Decision Making Units (DMUs) are ranked using VIKOR index.

Table 9: Si, Ri, Qi Values & Rank (2016 – 2017)

DMU	Si	Ri	Qi	Rank
HL	0.1693	0.0745	0.0137	2
SWL	0.2789	0.2743	0.4995	6
EWL	0.1221	0.1221	0.1065	5
GS	0.0913	0.0677	0.0322	3
CSS	0.0936	0.0883	0.0598	4
5WLS	0.0906	0.0677	0	1
SSS	0.4999	0.4999	0.9617	10
WL	0.387	0.3461	0.7487	8
EFL	0.4681	0.4598	0.9536	9
SSS C&F	0.3742	0.3462	0.6802	7

Source: Computed

The above Table 9 states that in both utility and regret measures, 5Way logistics solutions is the best alternative having the lowest index value of 0 and the most dominant company among other alternatives during the year 2015-2016. After calculating utility and regret measures, VIKOR index (Q_i) is calculated for the optimal solution. The alternative DMUs are ranked using VIKOR index.

Table 10: Si, Ri, Qi Values & Rank (2017 – 2018)

DMU	Si	Ri	Qi	Rank
HL	0.2075	0.0829	0.0415	2
SWL	0.5937	0.3056	0.5999	6
EWL	0.217	0.1221	0.0946	5
GS	0.1979	0.0926	0.0455	3
CSS	0.2253	0.0805	0.0525	4
5WLS	0.1714	0.0712	0	1
SSS	0.8181	0.4999	1	10
WL	0.8084	0.3953	0.8705	9
EFL	0.6881	0.3428	0.7163	7

SSS C&F	0.6895	0.3967	0.7801	8

Source: Computed

The above Table 10 states that in both utility and regret measures, 5Way logistics solutions is the best alternative having the lowest index value of 0 and the most dominant company among other alternatives during the year 2015-2016. After calculating utility and regret measures, VIKOR index (Qi) is calculated for the optimal solution. The alternative DMUs are ranked using VIKOR index.

Table 11: Si, Ri, Qi Values & Rank (2018 – 2019)

DMU	Si	Ri	Qi	Rank
HL	0.1547	0.062	0.5	6
SWL	0.2422	0.1038	0.1195	5
EWL	0.2082	0.1221	0.1125	4
GS	0.2148	0.0709	0.0594	2
CSS	0.2293	0.0713	0.0718	3
5WLS	0.1678	0.0697	0.0195	1
SSS	0.7644	0.4999	1	10
WL	0.5977	0.3123	0.649	8
EFL	0.7025	0.3622	0.7919	9
SSS C&F	0.5498	0.2704	0.5619	7

Source: Computed

The above Table 10 states that in both utility and regret measures, 5Way logistics solutions is the best alternative having the lowest index value of 0 and the most dominant company among other alternatives during the year 2015-2016. After calculating utility and regret measures, VIKOR index (Qi) is calculated for the optimal solution. The alternative DMUs are ranked using VIKOR index.

SUGGESTIONS:

Companies must measure their success in today's competitive market. Companies that rank their performance will improve, and this reality forces companies to rank their performance. To improve their efficiency and reliability, businesses must recognize their strengths and shortcomings to increase their efficiency and reliability, so that they attain competitive ability for increasing their market share.

CONCLUSION:

In today's competitive environment, a company's expansion and growth are dependent on assessing performance and making suitable decisions. Such kind of evaluation will help to understand the key parameters which decide the performance. The success or failure of a service is determined by a number of factors. MCDM approaches were used to examine the requirement and importance of evaluating and ranking the performance of Clearing and Forwarding Agent Companies in this as they play a prominent role in the economy.

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