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Ranking of the Logistics Risk Factors and Risk Management Tools via Integrated AHP-VIKOR Approach: A Case Study of Samsun Province

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Extensive Summary

Introduction

Today, firms that want to survive in the international market need to pay more attention to the risk criteria in all fields. Developing and changing logistics applications at both World and Turkey has becoming diverse day by day and therefore contain a lot of risk factors.

Unlike traditional supply chain applications, cold chain logistics, is at risk because of the operational processes of the products are elaborated and the products within the cold chain from production to end consumer is perishable (Wei, 2011: 12). From this point of view, the one of the important issues is sustainability. One way of achieving sustainability is to reduce the level of impact of risk factors to the minimum, or to work on zero risk components. Because the logistic risk factors at cold chain and cold chain transportation are components that directly affect the firm at points of competition, efficiency, cost, customer satisfaction, effectiveness etc. One of the best ways to create these components at firms is through logistic risk factors.

The identification of the risk factors in cold chain logistics and the harmonization of logistics risk factors with the ideal logistics risk management tool can be considered as applications that bring success to the firms.

Accordingly , the aim of this study is to identify the logistic risk factors in firms, which are carrying out cold chain transportation in Samsun province and to rank the tools used in logistic risk management.

To the best our knowledge, it is the first study for identifying logistic risk factors and for ranking logistic risk management tools in firms that are involved in cold chain transportation. Also to the best our knowledge, it is the first study that is utilized the AHP-VIKOR integrated approach for supply chain risk management. For this reason, it is evaluated that this study will contribute to the literature.

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In the following sections of the study, respectively, the literature research on logistic risk, the Analytical Hierarchy Process (AHP) and the Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) methods, which are the methods of the study, and the application of the method to Samsun province are handled. The last section draws conclusions and comments on future study directions.

Method

In this study, a two-stage integrated multi-criteria decision making (MCDM) approach was used to identify logistic risk factors and the most ideal logistic risk management tool for firms that carry out cold chain transportation. The weights of criteria were determined by AHP and at the second stage the alternatives were ranked by using the obtained weights and by utilizing the VIKOR method.

Analytic Hierarchy Process (AHP)

AHP, developed by Thomas L. Saaty in 1977, is one of the widely used MCDM methods to solve complex problems. This method ranks the decision alternatives in order to importance within the criteria determined by the decision maker in many options (Erdal and Akgün, 2014:93).

The computational steps of AHP can be summarized as follows: (Erdal, 2014:56-62; Yapraklı and Erdal, 2015:488-489).

Step 1: State the problem. Structure the problem in a hierarchy of different levels constituting goal, criteria, sub-criteria and alternatives.

Step 2: Compare each element in the corresponding level and calibrate them on the numerical scale.

Step 3: Calculate the mean relative weights.

Step 4: Calculate the degree of consistency.

VIKOR Method

The VIKOR method was presented in 1998 by Serafim Opricovic and was formed by abbreviating the initials of Slavic expressions (Opricovic and Tzeng, 2004: 447). This method; helping the decision maker to achieve a final decision by focusing on the identification of a compromise solution of a problem with contradictory expressions and the ranking of a set of selected alternatives (Opricovic and Tzeng, 2007: 515).

The computational steps of VIKOR method can be summarized as follows (Opricovic and Tzeng, 2007; 515-517; Güzel and Erdal, 2015: 54-55);

Step 1: Determine the best (f_i^*) and the worst (f_i^-) values of all criterion ratings.

Step 2: Compute the values S_j and R_j.

Step 3: Compute the values Q_j.

Step 4: Rank the alternatives, sorting by the values S_j, R_j and Q_j in decreasing order.

Step 5: Determine a compromise solution, the alternative A^1, which is the best ranked by the measure Q_{min} . If the following two conditions are satisfied.

• Acceptable advantage: $Q_{A^{(2)}} - Q_{A^{(1)}} \geq 1/(j-1)$, where A^2, is the alternative with second position according to the ranking list by Q_j;

• Acceptable stability in decision making: The alternative A^1, must also be the best ranked by S_j or/and R_j. This compromise solution is stable within a decision making process, which could be: "voting by majority rule" (when v>0,5 is needed), or "by consensus" (v=5), or "with veto" (v<5).

Results

Weighting The Criteria

In this section of the AHP method, a questionnaire for the comparison of 25 experts was conducted to evaluate the criteria. Consistency analysis of the model was performed and the CR value was computed as 0.096. If CR is less than 0.10, the matrix comparison is an indication that the result is consistent.

As a result of the AHP calculations, the most important logistic risk factors was determined as "Packaging Risks" in cold chain transportation firms. "Transportation Risks", "Organizational Risks" and "Purchasing Risks" were determined as other risk factors in the firms, respectively. "Inventory Risks" was the least important logistic risk factor.

Ranking The Alternatives

In this section, the VIKOR method was utilized for sorting the alternatives. By using the weights of the criteria obtained by AHP, VIKOR method was utilized to select the best tool for logistic risk management. Assessment of each alternative in the framework of previously determined decision criteria was made with the VIKOR questionnaire. According to the method, the f_i^*, f_i^-, S_j, R_j, and the Q_j values were calculated, respectively.

As a result of the calculations, the most important logistic risk management tool was "Statistical Process Control (A5)". The logistics risk management tool with the least precaution was designated as "Process Capacity Analysis (A2)".

Conclusion

In this study, logistic risk factors were prioritized for the firms that carry out cold chain transportation in Samsun province and the tools used in logistic risk management were ranked.

In this context, a two-stage approach was applied. At the first stage, related risk criteria were weighted by AHP method by using expert opinions, academicians, logistics service providers and literature review to determine logistic risk factors in Samsun province. As a result of calculations, "Packaging Risks (K5)" became the most important main criterion.

At the second stage, logistic risk management tools were ranked. "Statistical Process Control (A5)" was determined the most ideal logistic risk management tool, and the least ideal was "Process Capacity Analysis (A2)".

This work was discussed with 25 experts who are considered to be parties to this subject, but this number couldn't been increased due to time constraints. Future works

can be extended with different experts from different sectors and fields of expertise to examine the impact of decision-makers on the decision.

Similarly, the proposed integrated approach for the cold chain logistics problem can be applied to different problem fields. In addition, this study can be extended in future works with other MCDM methods, and/or parametric or nonparametric methods or fuzzy logic and the results can be compared.