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PRIORITIZING THE INTERNAL AND EXTERNAL FACTORS LEADING FIRMS TO GREEN LOGISTIC: A CASE STUDY FOR FOOD FIRMS

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Abstract

A combination of increased environmental awareness by governments and the significance attached to the green applications by businesses, customers and suppliers have contributed to the elevation of the status of sustainable business environment. Regulations have led firms to come up with environment-friendly green strategies leading the prominence of the green concept which gives great consideration to the constrained natural resources. Green logistics is one of the green concepts followed by most businesses today. These applications are one of the emphasized points that provide customer satisfaction, competitive and market advantage day by day.
This study sought to evaluate the internal and external factors that guide the green logistic decisions of firms. The study followed a case study on firms in the food sector with 10 and more employees in Samsun province. The factors considered were obtained through in-depth literature review and, Entropy as an MCDM method was selected for prioritizing the factors. The results show that 'Eco-Efficiency' was the most important factor leading firms to green logistic and 'Social Pressure' was the least important factor.

Key words*: Green Logistic, Internal and External Factors of Green Logistic, MCDM, Entropy Method.*

1 INTRODUCTION

Being able to achieve sustainable development while ensuring environmental protection is one of the biggest challenges that society and economies face today. The perception by humanity throughout history of natural resources as an unlimited entity has led to extensive environmental problems on a global scale. The extent reached by these environmental concerns has led to global anxiety and has necessitated the development of common policies between countries and the creation of implementation plans [1].

One of the areas of policy change and practice is green logistics practices. As a concept, green logistics may be defined as a way of ensuring sustainable production, packaging, storage and distribution of goods by evaluating their social and environmental factors [2]. Guirong et al., (2010), on the other hand, defined it as the environmental friendly practices of businesses, customers, society and the political system regarding the relationship created between green suppliers and consumers in the timely delivery of products and services [3].

Green logistics has also been defined by its ability of understanding and minimizing its ecological effects, and therefore it is also called ecological logistics [4].
The most effective use of supply chains as a goal of green logistics is in the coordination and planning of cost reduction. Initially, only the monetary aspect was considered as the cost. This has since been expanded to include the additional cost of the logistics process (air pollution, climate change, etc.) [5].

Generally, green logistics practices are attained simply by considering and putting in action the environmental innovations in existing logistics. Environmental innovations ensure a series of significant cost advantages and efficiency to the business starting from product design stage throughout the whole logistics process. Some of the advantages include storage optimization, development of production techniques using less resources and materials, reduction of treatment and disposal processes through less waste production, and the use of less raw materials through recycling. The resulting cost advantage contributes to improved efficiency and financial performance as well as operational performance [6].
As can be understood from the definitions above, green logistics and its applications are some of the ways in which we ensure that the present day is protected, and a legacy is guaranteed for the future generations. The theme of sustainability and its significance, which has become increasingly present in decision making recently, has led both the private and public sectors to more environmentalist approaches. These approaches have undoubtedly brought along various applications [7].

The decision by most businesses to implement green logistics may be attributed to, among others, corporate pressures, legal pressures, customer pressures and economic pressures [8]. However, Keskin, (2017) credits these implementations to the potential advantages that these businesses seek reap from such actions including reduction in CO2 emissions, significant cost advantages and savings, increased supply chain operations and optimization, and

increased operating performance. In other words, the execution of green logistics by itself is beneficial to the businesses hence the decision including them in their operations [9].

The factors that drive the green logistics agenda of enterprises may be both internal and external. These may include factors like customer demands and expectations [10,11], competitive advantage and market conditions [12], eco-efficiency [13], supplier pressure [14], economic pressures [15], need for compliance/ national and international legislations and laws [16], ecological and ethical approach/social pressures [17,18] and technological developments [19].

The aim of this study was to prioritize and rank the internal and external factors that drive the green logistics agenda of companies in the food businesses with a corporate identity and more employees in the province of Samsun. The remaining sections of the study include a literature review covering the studies on green logistics and its implementation. This is followed by the presentation of the findings of the ENTROPY method used to determine and rank the internal and external factors that lead businesses to green logistics. The study then concludes with a general discussion section that presents the conclusion of the study and outlines the limitations of the research and suggestions for future studies.

2 LITERATURE REVIEW

Here are some of the studies on green logistics and its implementations in businesses.

Gunesekaran et al. (2001) analyzed the effects of green logistics practices on reducing costs and effective use of resources [20]. Daugherty et al. (2005) investigated the effect of green logistics practices on the profit margins of businesses [21]. Talbot et al., (2007) stated that green supply chain practices will create a competitive advantage and have a positive effect on economic performance [22]. Chan et al., (2010) determined the effect of green logistics practices on inventory cost in their research [23]. Park and Yeo (2012) evaluated the five major Korean ports in terms of green port implementation using the Green Port Scale (GCS) [24]. Atrek and Özdağoğlu, (2014) performed a study that was intended to provide data to help understand the current status of green supply chain practices [25]. Zavodska et al., (2015) investigated the effect of green logistics practices on the energy efficiency and costs of the enterprise [26].

Korucuk and Mert (2017) examined the effect the different levels of green logistics practices on the departments at the PTT and concluded that not much importance is attached to green logistics practices in these units [27]. Dinçer and Dişkaya, (2018) proposed a mathematical model for the green vehicle routing problem, which is a type of vehicle routing system used to optimize distribution networks [28]. Hutomo et al., (2018) examined the effects of green logistics practices on sustainable performance in fish farms in Indonesia [29]. Korucuk (2018) looked at the effect of green logistics practices on competitiveness and hospital performance [30].

Stolka-Sereko and Kubicka-Ociepa, (2019) examined the relations and effects of green logistics and transformation economy [31]. Karamaşa (2020) analyzed the green logistics practices in food businesses using the neutrophic dematel method [7].

From the studies highlighted above, there is a lack of sufficient studies examining the importance levels of internal and external factors that lead businesses to green logistics. This study seeks to remedy an oversight in literature of an issue that needs to be emphasized. Additionally, the study will contribute to the literature in terms of the method and application area used.

3 METHODOLOGY

The study used the ENTROPY method, which is a Multi-Criteria Decision Making (MCDM) method, to determine the degree of importance of the internal and external factors that drive companies to green logistics. Businesses in the food sector with 10 or more employees in Samsun were considered. MCDM methods are applied in a different way from statistical analysis techniques, that is, they evaluate both objective and non-objective factors together. Analyzes are carried out based on expert opinions, and the study can be shaped according to the opinion of a single expert or the opinion of a group of experts [32]. This section explains ENTROPY method, which is used to evaluate the criteria for considering internal and external factors that lead businesses to green logistics.

3.1. The ENTROPY Method

The ENTROPY method is one of the weighting methods that conveys the truth. ENTROPY effectively explains the maximum uncertainty or minimum certainty for the identified problem and eliminates human-induced errors. In practice, as the value in the method decreases, the degree of irregularity decreases [33,34].

The application steps of the ENTROPY method are given as below [35]:

Step 1. Creation of the Decision Matrix: For the multi-criteria decision problem with *m* decision alternatives and *n* evaluation criteria, the initial decision matrix is created as shown.

$$X_{mxn} = \begin{matrix} X_{11} & X_{12} \dots & X_{1j} \\ X_{22} \dots & X_{2j} \\ \vdots \\ X_{i1} & X_{i2} & X_{ij} \end{matrix} \quad (1)$$

Step 2. Normalization of the Normalizing the Decision Matrix: In the normalization process, the following formulas are applied according to whether the criteria are benefit (2) or cost (3) oriented:

$$P_{ij} = \frac{X_{ij} - X_j^{min}}{X_j^{max} - X_j^{min}} \qquad i = 1,\dots..,m;\ j = 1,\dots..,n \quad (2)$$

$$P_{ij} = \frac{X_j^{max} - X_{ij}}{X_j^{max} - X_j^{min}} \qquad i = 1,\dots..,m;\ j = 1,\dots..,n \quad (3)$$

After the initial matrix is normalized, it is represented in the R=[rij]mxn matrix and Eq. (4) is used.

$$P_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}} \quad (4)$$

Step 3. Calculation of the Entropy Value The entropy value (Ej) is calculated as Eq. (5):

$$E_j = -k\sum_{i=1}^{m} P_{ij} ln(P_{ij}) \quad (5)$$

Where the value of k is calculated using the formula k = $(\ln(m))^{-1}$.

Step 4. Calculation of the Degree of Differentiation and the Weight of Entropy: The degree of differentiation of the entropy value (dj) is calculated as Eq. (6):

$$d_j = 1\text{-}E_j\,;\ V_j \quad (6)$$

The objective weight (Wj) of each criterion is defined according to Eq. (7):

$$W_j = \frac{d_j}{\sum_{j=1}^{n} d_j},\ V_j \quad (7)$$

4 APPLICATION

The study created a multi-criteria decision model to determine the internal and external factors that drive food businesses to green logistics. Accordingly, to determine the criteria in the determination of internal and external factors that lead food companies to green logistics, first, a comprehensive review of the literature was done followed by and expert opinions according to the decision model. And since the levels of of importance of the determined criteria are different, there was a need to prioritize them.

Thus, the internal and external factors that lead food companies to green logistics were ranked using the ENTROPY method.

In determining the criteria, a total of 5 expert opinions (food business managers (4) and academicians (1)) were taken into consideration. This and an in-depth the literature review on the subject led to the criteria in Table 1 below.

Table 1. Decision Criteria

Criteria	Mark
Customer Demands and Expectations	C1
Competitive and Market Conditions Advantage	C2
Eco-Efficiency	C3
Supplier Pressure	C4
Economic Pressures	C5
Compliance (National and International Legislation / Laws)	C6
Social Pressures	C7
Technological Developments	C8

4.1. Weighting of Criteria

At this stage, a comparison questionnaire was created to evaluate the criteria using ENTROPY method. A total of 5 experts who are the stakeholders of the subject were presented with a questionnaire. These included 4 food business managers and an academician. The application steps of the ENTROPY method followed in the study are presented in the tables below. Table 2 gives the Decision Matrix of the study.

Table 2. Decision Matrix

	A_1	A_2	A_3	A_4	A_5
C_1	4	5	2	5	6
C_2	6	5	2	6	6
C_3	5	7	4	2	1
C_4	2	4	6	3	3
C_5	3	3	3	4	5
C_6	6	8	7	5	2
C_7	4	3	5	4	3
C_8	4	5	6	2	7

Since the names of the food companies and the name of the academician cannot be given, each business and academician is numbered from "A1 to A5", respectively as shown in Table 3 below.

Table. 3 Normalized Decision Matrix

	A_1	A_2	A_3	A_4	A_5
C_1	0,182	0,227	0,091	0,227	0,273
C_2	0,240	0,200	0,080	0,240	0,240
C_3	0,263	0,368	0,211	0,105	0,053
C_4	0,111	0,222	0,333	0,167	0,167
C_5	0,167	0,167	0,167	0,222	0,278
C_6	0,214	0,286	0,250	0,179	0,071
C_7	0,211	0,158	0,263	0,211	0,158
C_8	0,167	0,208	0,250	0,083	0,292

The results of the analysis are given in Table 4.

Table 4. Criterion Weights

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
Weight	0,122	0,123	0,148	0,125	0,115	0,128	0,113	0,126
Rank	6	5	1	4	7	2	8	3

The results in Table 4 show that the most important factor driving food companies to green logistics is "Eco-Efficiency". This is followed by "Compliance (National and International Legislation / Laws)", "Technological Developments", "Supplier Pressure", "Competitive and Market Conditions Advantage" and "Customer Demands and Expectations", respectively.

On the other hand, “Social Pressures” factor at the bottom of the list as the factor of the least importance followed by "Economic Pressures".

5. CONCLUSION AND DISCUSSION

Today, governments and companies are more meticulous and careful about nature and its sustainability. There is therefore a lot of effort aimed at the implementation of various policies, strategies, incentives and practices aimed at leaving a livable environment for future generations.

The production and presentation of goods and services to the customer in a way that causes the least harm to the environment are considered as some of the important

components that accord businesses a competitive advantage and cost optimization. One of these components is green logistics practices specific to businesses.

This study was intended to determine the importance levels of the various internal and external factors that drive food companies to green logistics based on a study of business in the Turkish city of Samsun with 10 or more employees. The results revealed that the most important factor that lead businesses to green logistics is "Eco-Efficiency". The other important factors include "Compliance (National and International Legislation / Laws)", "Technological Developments", "Supplier Pressure", "Competitive and Market Conditions Advantage" and "Customer Demands and Expectations", respectively. “Social Pressures” factor was the factor with the least importance. This was followed by “Economic Pressures".

The findings obtained in the study only contain results for businesses operating in the food sector. Future studies may widen their scopes to include different sectors as well as use other selection-based Multi-Criteria Decision-Making methods to do the ranking.

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