SUPPLY CHAIN MANAGEMENT DURING THE COVID 19 PANDEMIC PERIOD EVALUATION OF STRUCTURAL PROBLEMS: AN APPLICATION ON GİRESUN HAZELNUT FIRMS

Ezgi DEMİR
Selçuk KORUCUK
Çağlar KARAMAŞA

Abstract: *Supply chains are important components in terms of effective production, service management, as well as the ability of businesses to fulfill their objectives and to compete. Especially the effective, economical and efficient operation of this structure provides cost advantage and increases customer satisfaction. However, some structural problems arise in terms of fulfilling the supply chain at the desired level, and these problems affect businesses negatively. In this study, it has been aimed to rate the supply chain management structural problems in the hazelnut firms in Giresun during the Covid 19 pandemic. Spherical fuzzy analytical hierarchy method, one of the Multi Criteria Decision Making methods, has been used in solving supply chain structural problems.*
Keywords: *Supply Chain Management, Supply Chain Management Structural Problems, Spherical Fuzzy AHP, MCDM, COVID-19, Hazelnut Firms.*

1. INTRODUCTION

In the globalizing world, there is a situation where technology becomes digital, developments in communication technologies, change in customer expectations and needs, increase in international integrations, and at the same time, competition takes place between supply chains. Therefore, the fact that everything changes very quickly requires the supply chain management to be operated more effectively and efficiently. So much so that in the period we experienced the Covid 19 pandemic, supply chain management has become a vital component for businesses to survive and ensure customer satisfaction at the desired level, besides being of special importance.

Christopher, (2011) stated that the supply chain can be seen as a network of forward and backward-linked organizations that encompass different processes and activities that will create value for the end consumer in the form of products and services.

Ayers (2000) expressed the concept of supply chain management as managing the process according to customer needs and demands of products and information obtained from suppliers. In another study, this concept; It uses advanced technology, information management and operations research mathematics to plan and control a component of factors, expanding to produce and deliver products and services in a better way to satisfy the customer. Supply chain management ensures that an organization meets the right products and services at the right time in the appropriate amount and at an acceptable cost (Ressel, 2001). It has been stated that the main purpose in supply chain management is a balance between customer demand and the flow of materials, products and information from the supplier in order to meet customer requests and needs on time (Krajewski et al., 2016).

The supply chain structurally begins with the purchase and acquisition of the goods to be sold. Then, inventory management and warehouse management are taken care of to support sales. And it ends with the delivery of the latest products to customers. In the supply chain, materials move from raw material sources to a production level that transforms these raw materials into semi-finished products. These semi-finished products have been then combined at the next level to form the finished products. The products obtained are transferred to distribution centers and from there to vendors and customers (Çizmeci, 2002).

Marr (2018), on the other hand, touched on the problems of the supply chain in his study. It has been stated that it is impossible to know the true value of a good for buyers and sellers due to the transparency of the system. So one of the main problems is the problem of transparency and information sharing. Similarly, in today's supply chain processes, it is difficult to keep track of who, when and where a transaction has been performed. In other words, it has been stated that there are problems in "determining the situations" in the transactions.

All manufacturing businesses have Supply Chain Management (SCM) systems. However, many of them are undeveloped, complex, or uncontrollable. Similarly, some businesses could not realize the full integration and unified functional system. In case the competitive position has been developed, it is necessary to examine where the business is on a continuous basis. Supply Chain Management sometimes causes a lot of time loss due to priority activities and therefore the desired level of application

cannot be achieved. Concentrating on wrong attempts causes unnecessary costs (Ciravoğlu, 2006). Effective management of the supply chain, which has a very important role in ensuring customer satisfaction, with the failure of production, making businesses sustainable, is a complex process as stated above, but has become even more complex during the pandemic period.

In this framework, it has been aimed to rate the structural problems of supply chain management in the hazelnut firms in Giresun during the Covid 19 pandemic period. Structural problems in supply chain management in general from the detailed literature review made as rating criteria; (Dejonckheere, 2004, Sunil & Sodhi, 2004, Magnan, 2008, Görçün, 2013, Soosayand Hyland, 2015, Marr, 2018, Singh, 2018) lowest resource use, highest added value, process planning efficiency, holistic design of processes, process improvement, bullwhip effect, difficulty in forecasting customer demands and process improvement at all stages have been determined.

The Spherical Fuzzy AHP method, which is one of the multi-criteria decision-making methods used in solving complex and complex problems, has been utilized.

In the second part of the study, the literature on structural problems of supply chain management has been researched. In the following section, the Spherical Fuzzy AHP method has been explained.The methodology has been applied to the problem in the fourth section, and the study has been ended with the conclusion section, which also includes suggestions in the fifth section.

2. LITERATURE REVIEW

Today, there are a limited number of studies on supply chain structural problems. Some of the studies carried out in this framework are as follows.

Metters (2002) found that the leading cause of the bullwhip effect is the distortion of information as it moves through the supply chain members.

Sunil and Sodhi, (2004), in their study, due to reasons such as long supply times, seasonality, production variability, short life cycle, insufficient customer support, they examined incorrect forecasts, sales promotions, incentives, lack of supply chain image and the distortion of information because of the excessive desire for underproduction or bullwhip effect of information.

Paksoy and Keskin (2006) discussed the effects of information distortion in the supply chain, the negative effects of this situation called the bullwhip effect in businesses and the solution methods.

Şen, (2008), in his study, investigated ways to increase the effectiveness of cold logistics applications in supply chain management and to store products with the least cost without losing quality.

Thomas and Skinner (2010) stated in their research that trust in supply chain relationships provides positive results such as cooperation, innovation, minimization of risk and increased potential profitability.

Liao et al. (2011) stated that high trust between parties in the supply chain can reduce risk, especially by enabling information sharing, and at the same time, a high level of supplier trust encourages more information exchange. It was stated that the reason for this is that the fear of the information being dispersed to different fields decreases as the trust increases.

Tez et al., (2012) investigated the solution and management of the problems encountered in the supply chain in the automotive sector with the failure mode and effect analysis (FMEA). It was stated that a proactive approach can be displayed by detecting the priority of possible problems and preventing them before they occur with FMEA, which is the most known of the prevention analysis.

Hoffman et al. (2013) found that transaction costs arising from supplier risk, environmental and behavioral uncertainties had a negative effect on business performance in their study on 207 companies.

Başkol, (2014) examined the effect of trust on the supply chain and various factors that create trust among supply chain members. It has been determined that the lack of trust among supply chain members negatively affects the performance success expected from the supply chain.

Canlı and Aplak, (2016), in a study on the defense sector, examined a supply chain management application with a methodological decision process approach that is valid in environments with uncertainty.

On the other hand, Pradabwong et al. (2017) revealed that process management and supply chain management have a common role within enterprises and in other inter-institutional practices, and that they improve organizational performance and collaborative activities positively.

Korucuk and Memiş (2018) prioritized risk factors in supply chain management using AHP technique, which is one of the multi-criteria decision-making methods.

Yarlıkaş and Arslaner, (2019) evaluated the importance levels of factors affecting global supply chain management using SWARA and COPELAND methods. As a result of the analysis, it was revealed that the most important criterion was "speed of implementation" and the least important criterion was "regulations".

Korucuk (2019) revealed the importance of supply chain management performance factors in his study using MCDM methods and made the most ideal competitive strategy choice.

Sawik (2020) examined the problems in supply chain optimization in his research and utilized multi-criteria decision-making methods to solve the supplier assessment and selection problem.

The limited number of studies on supply chain management structural problems in the literature review makes this study important. Likewise, the fact that there is no other study about the method used and the province of Giresun where the study is the subject makes the study different from other studies. From this point of view, it is thought that the study will contribute to the literature. At the same time, the Spherical Fuzzy Sets used in the study make a difference because it is a new method in the literature.

3. METHODOLOGY

The concept of SFS (Spherical Fuzzy Sets) enables an extended option area for decision experts to define membership degrees the squared sum of the spherical parameters has been at (Gündoğdu and Kahraman 2019).

3.1. Spherical Fuzzy AHP

In this study, the main criteria weights have been determined by Spherical Fuzzy AHP using Spherical Fuzzy Numbers. The stages of the proposed integrated methodology have been detailed in the next stages.

Stage 1. Determine criteria with respect to literature and alternatives by project decision maker for this problem.

Stage 2. Gathered information from decision makers to build pairwise comparison matrices. The decision makers define their assessments using linguistic terms given in (Gündoğdu ve Kahraman 2020).

Stage 3. Organize spherical fuzzy pairwise comparison matrices using the linguistic terms among all the criteria for two hierarchical levels of criteria.

$$A=\begin{bmatrix} 1 & \tilde{a}_{12} \dots \dots & \tilde{a}_{1n} \\ \tilde{a}_{21} \\ \vdots & \dots\dots & \tilde{a}_{2n} \\ \tilde{a}_{n1} & \tilde{a}_{n2} \dots\dots & 1 \\ \vdots & \vdots & \end{bmatrix} \quad (1)$$

Suppose that $\tilde{a}_{ij}$ is the pairwise comparison i and j.

Stage 4. Compute score indices (SI) of each member of matrix using pairwise comparison using Eq.2 and Eq.3 for having importance (AMI,VHI, HI, SHI, EI, SLI, LI, VLI, ALI).

$$SI = \sqrt{|100[\left(\mu_{\tilde{a}_{ij}}^2 - \pi_{\tilde{a}_{ij}}^2\right)^2 - \left(\nu_{\tilde{a}_{ij}}^2 - \pi_{\tilde{a}_{ij}}^2\right)^2]|} \quad (2)$$

$$\frac{1}{SI} = \frac{1}{\sqrt{|100[\left(\mu_{\tilde{a}_{ij}}^2 - \pi_{\tilde{a}_{ij}}^2\right)^2 - \left(\nu_{\tilde{a}_{ij}}^2 - \pi_{\tilde{a}_{ij}}^2\right)^2]|}} \quad (3)$$

Stage 5. Examine the consistency of the being built pairwise comparison matrices using score indices. Use score indices computed in Stage 4 to determine the consistency ratio (CR) of a matrix as asserted by (Saaty 1977). Consistency Index (CI) of matrix has been computed by Eq. 4.

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

CR has been computed by Eq. 5:

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

λmax is the maximum or principal eigenvalue of the decision matrix of pairwise comparison. Random index (RI) depends on matrix order (n) and has been computed and the consistency ratio has been computed as less than 0.1, the relevant matrix will have been accepted as consistent. For this way, the weight calculation stage has been began.

Stage 6. Compute the Spherical Fuzzy AHP weights with respect to each criterion using a spherical weighted arithmetical mean (WM) operator given in Eq.6.

$$SWAM(\widetilde{\tilde{a}_1}, \widetilde{\tilde{a}_2}, \dots, \tilde{a}_n) = \tilde{S}\left(\sqrt{1 - \prod_{i=1}^{n}(1-\mu_{\tilde{a}_i}^2)^w}, \prod_{i=1}^{n}\nu_{\tilde{a}_i}^w, \sqrt{\prod_{i=1}^{n}(1-\mu_{\tilde{a}_i}^2)^\lambda - \prod_{i=1}^{n}(1-\mu_{\tilde{a}_i}^2-\pi_{\tilde{a}_i}^2)^w}\right) \quad (6)$$

n has been defined as the number of criteria and also w= $\frac{1}{n}$.

Stage 7. Defuzzify spherical fuzzy numbers to indicate the importance levels of the criteria, using Eq. 7.

$$\tilde{S}_{WM} = \sqrt{100[\left(3.\mu_{\widetilde{WM}} - \pi_{\frac{\widetilde{WM}}{2}}\right)^2 - (\nu_{\frac{\widetilde{WM}}{2}} - \pi_{\widetilde{WM}})^2]} \quad (7)$$

Stage 8. Normalize the defuzzied criteria weights using Eq. 8

$$W_j = \frac{S(\widetilde{WM}_j)}{\sum_{i=1}^{n} S(\widetilde{WM}_{ij})} \quad (8)$$

4. APPLICATION

Spherical fuzzy sets handle decision makers' value judgments as membership function, non-membership function and hesitancy value. Spherical fuzzy sets give better results than other fuzzy sets because they deal with problems in 3 dimensions. In this study, 8 criteria were determined with the help of the literature and decision makers for the management of the covid-19 pandemic. 3 decision makers have reached a consensus in their decision. This project was managed by 3 decision makers who were previously involved in the unexpected crisis processes of the business. These decision makers have been managing supply chain management for 15 years. A consensus has been reached that the study should be examined in accordance with the fuzzy decision-making methodology during the crisis, as the net results were not known and could not be reflected in sales and income flow. In recent years, Spherical Fuzzy Decision-Making methodology, which is an advanced synthesis of other fuzzy decision making methods, has been preferred because it has gained general acceptance. In this context, the linguistic terms and values of the criteria according to the Spherical Fuzzy Analytical Hierarchy Method have been defined in Table 1. The linguistic values of the existing decision makers at the point of defining the superiority of the criteria compared to each other have been stated in Table 2**.** Since the first wave process of the Covid-19 pandemic has been successfully managed, it has been aimed to be a roadmap for other businesses by sharing it in the literature against the second or third wave risk through this study. Spherical Fuzzy AHP has been applied for parsing and binary comparisons for various levels of the hierarchy. The aim is to set priority criteria to rank.

In Spherical Fuzzy AHP Methodology, linguistic terms and triangular values have been defined as Table 1.

Table 1. Linguistic Terms and Values (Kahraman, Gundogdu, 2019)

Linguistic Meanings	Linguistic Terms	μ	V	π
Absolutely more Importance	AMI	0,9	0,1	0
Very High Importance	VHI	0,8	0,2	0,1
High Importance	HI	0,7	0,3	0,2
Slightly More Importance	SMI	0,6	0,4	0,3
Equally Importance	EI	0,5	0,4	0,4
Slightly Low Importance	SLI	0,4	0,6	0,3
Low Importance	LI	0,3	0,7	0,2
Very Low Importance	VLI	0,2	0,8	0,1
Absolutely Low Importance	ALI	0,1	0,9	0

Spherical Fuzzy AHP, a newly developed method, has been applied for weighting the criteria. The weight of the 8 criteria has been determined using Spherical Fuzzy AHP. Thus, the criteria created for this newly emerging situation have been handled with a new technique. The paired comparisons for decision makers according to the criteria in the order above are given in Table 2.

Table 2. The paired comparisons for decision makers

DM1	C1	C2	C3	C4	C5	C6	C7	C8
C1	1	EI	EI	EI	AMI	EI	HI	EI
C2		1	EI	EI	SLI	SLI	EI	EI
C3			1	EI	AMI	SLI	SMI	SLI
C4				1	LI	SLI	SLI	LI
C5					1	SLI	SMI	LI
C6						1	SMI	EI
C7							1	SLI
C8								1

Criteria weights in Table 2 were obtained using Equation formulas between 1 and 8. Results are given in Table 3. The spherical arithmetic mean (SWAM)and the spherical weighted geometric mean were both made. When we examined the criterion weights, it was revealed that the 12th criterion was the most important criterion. Therefore, the changing needs of customers are important during the pandemic period. This criterion was followed by the 10th criterion in terms of importance. It can be said that the data of this new period are in need of analysis. It cannot be stated that the importance of this criterion is an independent result from the 12th criterion.

Table 3. Criteria weights

Criteria	Weights
C1	0.161626
C2	0.07823
C3	0.187336
C4	0.062343
C5	0.099076
C6	0.106782
C7	0.189279
C8	0.105572

5. RESULTS

The limited number of studies on supply chain management structural problems in the literature review makes this study important. Likewise, the fact that there is no other study about the method used and the province of Giresun where the study is the subject makes the study different from other studies. From this point of view, it is thought that the study will contribute to the literature. At the same time, the Spherical Fuzzy Sets used in the study make a difference because it is a new method in the literature. For this purpose, the criteria has been ranked as difficulty in predicting customer demands> process planning effectiveness > Lowest resource usage> Bullwhip effect> Process improvement at every stage> Development of processes> The highest added value> Holistic design of processes.

References

Ayers, J. (2000). Handbook of Supply Chain Management. London, UK: St. Lucie Press.

Başkol, M, (2014), TEDARİK ZİNCİRİ İLİŞKİLERİNDE BAŞARI FAKTÖRÜ OLARAK GÜVEN UNSURU: KAVRAMSAL BİR ÇALIŞMA, Uluslararası Yönetim İktisat ve İşletme Dergisi, Cilt 10, Sayı 21, 129-146.

Canlı, K,A, ve Aplak, S,A, (2016), Belirsizlik İçeren Tedarik Zinciri Yönetimi Karar Süreçlerinde Savunma Sektörüne Yönelik Bir Uygulama, Güvenlik Stratejileri Yıl: 12 Sayı: 24, 71-109.

Ciravoğlu, G. (2006). Tedarik Zinciri Yönetimi Uygulamaları Ve Performans Üzerine Etkilerinin Analizi. Yayımlanmamış yüksek lisans tezi, Trakya Üniversitesi Sosyal Bilimler Enstitüsü.

ÇİZMECİ, F, (2002), Tedarik Zinciri Yönetimi, Alfa Basım Yayım, Ocak.

Christopher, Martin (2011). Logistics and Supply Chain Management, 4th ed., Pearson Education .

DEJONCKHEERE, J., DISNEY, S. M., LAMBRECHT, M. R., TOWILL, D. R., (2004,) The impact of information enrichment on the bullwhip effect in supply chains: a control engineering perspective, European Journal of Operational Research 153, 727- 750.

Görçün, Ö,F, 82013), Örnek Olay ve Uygulamalarla Tedarik Zinciri Yönetimi, 2. Baskı, Beta Basım Yayım Dağıtım A.Ş. İstanbul.

Hoffmann, P., Schiele, H. & Krabbendam, K. (2013). Uncertainty, Supply Risk Management and Their Impact on Performance. Journal of Purchasing and Supply Management, 19, 199-211.

Korucuk, S , Memiş, S . (2018). Tedarik Zinciri Yönetimindeki Risk Faktörlerinin AHP ile Ölçülmesi: Erzurum İli Örneği . Bitlis Eren Üniversitesi Sosyal Bilimler Dergisi , 7 (2) , 1036-1051 .

Korucuk, S . (2019). ÇKKV Yöntemleri İle İmalat İşletmelerinde TZY Performans Faktörlerinin Önem Derecelerinin Belirlenmesi ve En İdeal Rekabet Stratejisi Seçimi: Ordu İli Örneği . Dokuz Eylül Üniversitesi İktisadi İdari Bilimler Fakültesi Dergisi , 33 (2) , 569-593

KRAJEWSKI, L. J., MALHOTRA, M. K. ve RITZMAN, L. P. (2016), Operations Management Processes and Supply Chains, Pearson.

Liao, K., Ma, Z., Jiung, J., & Ke, K. (2011). Achieving mass customization through trustdriven information sharing: a supplier's perspective. Management Research Review, 34(5), 541-552.

Magnan, Gregory M., Stanley E. Fawcett, ve Matthew W. McCarter. 2008. "Benefits, barriers, and bridges to effective supply chain management". Supply Chain Management: An International Journal 13 (1): 35-48. https://doi.org/10.1108/13598540810850300.

Marr, Bernard. 2018. "How Blockchain Will Transform The Supply Chain and Logistics Industry". Forbes. 2018. https://www.forbes.com/sites/bernardmarr/2018/03/23/how-blockchain-willtransform-the-supply-chain-and-logistics-industry/. Limited.

METTERS, R., (2002), Quantifying the bullwhip effect in supply chains, Journal of Operations Management 15 (2), 89-100.

Paksoy, T ve Keskin, E, (2006), TEDARİK ZİNCİRİNDE BİLGİ ÇARPITMASININ ETKİSİ: KIRBAÇ ETKİSİ, Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 15, 483-496.

Pradabwong, J., Braziotis, C., Tannock, J., & Pawar, K. S. (2017). Business process management and supply chain collaboration: effects on performance and competitiveness. Supply Chain Management: An International Journal, 22(2)

RESSEL, Kay, (2001), "Supply Management", Computerword.

Sawiik, B, (2020), (2020), "Selected Multiple Criteria Supply Chain Optimization Problems", Lawrence, K.D. and Pai, D.R. (Ed.) *Applications of Management Science* (*Applications of Management Science, Vol. 20*), Emerald Publishing Limited, pp. 31-58.

Singh, Harjit, R. Garg, ve Anish Sachdeva. (2018). "Supply Chain Collaboration: A State-of-the-Art Literature Review". Uncertain Supply Chain Management 6, (2): 149-80.

Soosay, C,A ve Hyland, P, (2015), "A decade of supply chain collaboration and directions for future research". Supply Chain Management: An International Journal 20 (Eylül): 613-30. https://doi.org/10.1108/SCM-06-2015-0217.

Sunil, C, ve Sodhi, S, m, (2004), Managing Risk to Avoid Supply-Chain Breakdown, MIT Sloan Management Review, 53-61.

Şen, A, (2008), TEDARİK ZİNCİRİ YÖNETİMİNDE SOĞUK LOJİSTİK UYGULAMALARININ ETKİNLİĞİNİN ARTTIRILMASINA YÖNELİK BİR ÇALIŞMA, Yayımlanmamış yüksek lisans tezi, Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü.

Tez, Özkan, H, Tez, E, ve Yılmaz, A, (2012), TEDARİK ZİNCİRİNDE KARŞILAŞILAN SORUNLARIN FMEA İLE ÇÖZÜMLENMESİ VE YÖNETİLMESİ: OTOMOTİV SEKTÖRÜNDE BİR UYGULAMA, ORGANİZASYON VE YÖNETİM BİLİMLERİ DERGİSİ Cilt 4, Sayı 2, 107-117.

Thomas, R., & Skinner, L. (2010). Total trust and trust asymmetry: does trust need to be equally distributed in interfirm relationships? Journal of Relationship Marketing, 9, 43–53.

Yarlıkaş, S , Arslaner, C . (2019). SWARA ve COPELAND Yöntemleri ile Global Tedarik Zinciri Yönetimini Etkileyen Faktörlerin Önem Düzeylerinin Değerlendirilmesi . Anadolu Üniversitesi Sosyal Bilimler Dergisi , 19 (4) , 83-104.

NOTES ON THE AUTHORS

Ezgi DEMİR, Piri Reis University, Istanbul, Turkey, edemir@pirireis.edu.tr (corresponding author)

Selçuk KORUCUK, Giresun University, Giresun, Turkey.

Çağlar KARAMAŞA Anadolu University, Eskişehir, Turkey.