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Evaluation of Supply Chain Resilience in N-11 Countries by MEREC Based EDAS, MARCOS, WASPAS Integrated Method

N-11 Ülkelerinde Tedarik Zinciri Dayanıklılığının MEREC Tabanlı EDAS, MARCOS, WASPAS Bütünleşik Yöntemiyle Değerlendirilmesi

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ABSTRACT

Supply chain resilience is an important factor in ensuring the growth and development of economies, as well as profitable operations in businesses. Because, unstable supply chains can cause an increase in operational costs, loss of workforce, and a decrease in economic mobility as a result of possible disruptions. In this study, supply chain resilience was evaluated considering the potential of N-11 countries. The Global Resilience Index data published by FM Global was used in the evaluation process, and the weights of the indicators related to the resilience of the supply chain were determined by the MEREC method. The relative rankings of the countries were then determined by the EDAS, MARCOS, and WASPAS methods. The resulting rankings were combined with the BORDA counting method to form the final rankings for supply chain resilience of N-11 countries. The focus on the subject and the methods used have given the research a unique identity. As a result of the calculations, Supply Chain Visibility and Corporate Governance indicators stand out as the most important indicators affecting supply chain resilience in N-11 countries, while South Korea and Türkiye are the two best countries in terms of supply chain resilience among N-11 countries. Various suggestions were made to researchers and practitioners in line with the findings.

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ÖZ

Tedarik zinciri dayanıklılığı, işletmelerde operasyonların kârlı bir şekilde gerçekleştirilebilmesinin yanı sıra ekonomilerde de büyümenin ve kalkınmanın sağlanabilmesinde önemli bir faktördür. Zira dayanıksız tedarik zincirleri, olası aksaklıklar neticesinde operasyon maliyetlerinin yükselmesine, iş gücü kaybına ve ekonomik hareketliliğin azalmasına neden olabil-

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mektedir. Bu çalışmada N-11 ülkelerinin sahip olduğu potansiyel göz önünde bulundurularak tedarik zinciri dayanıklılıkları değerlendirilmiştir. Değerlendirme işleminde FM Global adlı kuruluş tarafından yayınlanan Küresel Dayanıklılık İndeksi verileri kullanılmış olup tedarik zinciri dayanıklılığına ilişkin göstergelerin ağırlıkları MEREC yöntemiyle, ülkelerin görece sıralamaları EDAS, MARCOS ve WASPAS yöntemleriyle belirlenmiştir. Elde edilen sıralamalar BORDA sayım yöntemiyle birleştirilerek N-11 ülkelerinin tedarik zinciri dayanıklılığına ilişkin nihai sıralamaları oluşturulmuştur. Odaklanılan konu ve kullanılan yöntemler, araştırmaya özgün bir kimlik kazandırmaktadır. Yapılan hesaplamalar sonucunda Tedarik Zinciri Görünürlüğü ve Kurumsal Yönetim göstergeleri N-11 ülkelerinde tedarik zinciri dayanıklılığını etkileyen en önemli göstergeler olarak ön plana çıkarken Güney Kore ve Türkiye'nin N-11 ülkeleri arasında tedarik zinciri dayanıklılığı bakımından en iyi iki ülke olduğu görülmüştür. Elde edilen bulgular doğrultusunda araştırmacılara ve uygulayıcılara çeşitli önerilerde bulunulmuştur.

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1. INTRODUCTION

Supply chains are networks of processes that involve stakeholders from different regions to produce and deliver final products or services to customers. These networks enable organizations with diverse structures and cultures to collaborate commercially and produce products and services that meet customer expectations under the most suitable conditions. Due to their impact on trade volumes, supply chains are regarded as one of the most crucial drivers of regional and global economic growth and development. As a matter of fact, disruptions in supply chains can create bottlenecks that have negative effects on economic productivity and growth. (Goel et al., 2021).

Despite limited resources, organizations are facing increasing customer requirements and shortening product life cycles, which are driving them to work in an integrated manner within supply chains. However, the competitive pressure caused by globalization is leading to the expansion of supply chain networks across the world. This situation transforms supply chains into complex structures and exposes them to various risk factors (Wagner & Bode, 2006). Furthermore, changing customer demands and global economic trends increase market uncertainty and diversify the associated risks, making the consequences of supply chain disruptions devastating. Therefore, the resilience of supply chain operations against potential disruptions is a critical issue that both managers and researchers are highly sensitive to.

Supply chain resilience refers to the ability of the chain to sustain operations continuously in the face of uncertainty and disruption. It encompasses the capacity of the supply chain to prepare for potential interruptions, react in a cost-effective manner in case of an interruption, and recover promptly (Ponomarov & Holcomb 2009). Thus, achieving supply chain resilience necessitates an approach that encompasses all stages and actors within the chain. Increasing flexibility in physical, financial, and operational aspects is a prerequisite for enhancing supply chain resilience, and this can only be accomplished through a comprehensive approach. For this approach to be implemented successfully, it is necessary to closely monitor all elements that have the potential to affect the supply chain, as well as supply chain activities.

Supply chain resilience has the potential to improve the profitability of supply chain operations by enhancing trust among supply chain actors and meeting customer expectations. However, in today's economic landscape, supply chains are connected on a global scale, resulting in unprecedented complexity in the flow of finished and semi-finished products. This flow increases the vulnerability of supply chains, giving rise to numerous risks and vulnerabilities. (Wagner & Bode, 2006). This situation compels organizations to adopt strategies aimed at enhancing the resilience of their supply chains. These strategies should enable the chain to remain resilient in the event of possible disruptions and quickly adapt to changing market conditions. However, the impact of these strategies may vary depending on the geographic conditions where the supply chain is operating (Gunasekaran et al., 2015). For instance, long-term strategies such as investing in new technologies may yield desirable outcomes for organizations operating in a stable economy, while shorter-term strategies like reducing costs or inventories may prove successful for organizations operating in volatile regions. Similarly, organizations operating in a trust-based cultural environment may opt for long-term strategies, whereas those operating in cultural conflict zones may prefer short-term strategies. Hence, managers seeking to enhance the resilience of their supply chains should closely monitor the dynamics of the regions in which they operate.

Unstable supply chains can impede economic development by causing financial losses, demand and supply mismatches, and destabilization of operational policies in pro-

duction, distribution, and inventory control due to possible disruptions (Ivanov, 2021). Therefore, monitoring and enhancing the resilience of supply chains is a crucial issue for policymakers. Additionally, policymakers should remain vigilant to potential problems and closely monitor the potential impact of changes in the global economic landscape on supply chains. This will help reduce supply chain risks and ensure uninterrupted access to the goods and services necessary for the citizens of the country.

Despite the significant impact of supply chain resilience on national economies, most research in this field focuses solely on its business aspect. For instance, Roberta Pereria et al. (2014) studied the identification of internal and inter-institutional problems that impact supply chain resilience, while Scholten and Schilder (2015) explored the role of cooperation in enhancing supply chain resilience. This creates a gap in the literature that neglects the national dimension of supply chain resilience. The main reason for this approach is the difficulty and complexity of measuring supply chain resilience at the national level. Nevertheless, despite the challenges involved, it remains crucial to address supply chain resilience at the national level. Therefore, this study aims to address this gap by examining the supply chain resilience of N-11 countries. These countries have the potential to become important supply centers in the future due to their resources and socioeconomic characteristics. In this context, in this study, the resilience of the supply chain of these countries was evaluated with multi-criteria decision-making (MCDM) methods using data on the supply chain section of the Global Resilience Index published by FM Global.

In the evaluation process, the weights of the indicators related to supply chain durability were determined by the MEREC method, and the supply chain durability rankings of the countries were determined separately with the EDAS, MARCOS and WASPAS methods. The rankings obtained later were combined with the BORDA counting method to form the final rankings of the countries. Thus, a study was carried out to fill the gap in the supply chain durability literature, and the decision-making literature was tried to be enriched by using current MCDM methods together. In this context, in the following parts of the study, firstly, the durability of the supply chain is discussed in general terms and the literature is summarized, then the methods used in the study are explained and the calculation results for these methods are reported. Finally, the findings were interpreted, and various suggestions were made to researchers and practitioners.

2. SUPPLY CHAIN RESILIENCE

Supply chain resilience is an indicator of organizations' ability to identify bottlenecks and potential risks related to the supply chain management process (Brandon-Jones et al., 2014). For this reason, in today's business environment where uncertainty and complexity are increasing, it is one of the issues that organizations should focus on to continue their activities uninterruptedly. Likewise, the durability of the supply chain allows the flow of semi-finished and finished products to continue, even in the event of unexpected and devastating changes at any point in the supply chain, making it possible for organizations to fulfill their commitments despite the problems experienced in the markets.

Supply chain resilience is a subject that is still being debated, with no clear definition available in the literature. Sprecher et al. (2015) suggest that supply chain resilience is the ability to obtain enough of a particular material to meet societal demands and to offer suitable alternatives if there is an inadequate supply. Ponomarov and Holcomb (2009) define supply chain resilience as the ability of the supply chain to be ready for unexpected disruptions and to maintain the continuity of operations at the desired level of control in case of interruptions. Similarly, Spiegler et al. (2012) view supply chain resilience as the adaptive capacity of the supply chain to plan for unforeseen events, respond to disruptions, and recover from them while maintaining continuity. Scholten et al. (2014) view supply chain resilience as a proactive approach to managing risks, defining it as the ability to respond to disruptions in the supply chain. This perspective emphasizes the importance of being prepared for unexpected events and having a plan in place to mitigate the impact of disruptions. From a slightly different perspective, Hearnshaw and Wilson (2013) view supply chain resilience as the ability to quickly recover from disruptions and to minimize the impact of these disruptions on customers. Sheffi (2015) presents a broader perspective on supply chain resilience, defining it as the ability to cope with the complexity of supply chains and to adapt to new challenges using a perspective that surpasses the constraints of traditional approaches.

Although supply chain resilience is discussed from different perspectives in the literature, these perspectives converge on the fact that the supply chain is resilient against disruptions and that it allows sufficient flow of finished and semi-finished products by quickly recovering in the face of possible adversities. In this context, for the purposes of this study, supply chain resilience is defined as the capacity of a supply chain to maintain the flow of finished and semi-finished products in the most economical way without interruption in the face of unexpected events.

The traditional approach to supply chain design is centered on efficiency and maximizing profitability by reducing waste. However, this narrow focus on efficiency can result in reduced flexibility and increased vulnerability in supply chains. Backup inventory or backup supplier policies need to be considered so that supply chains can be designed to absorb unexpected outages and quickly restore operations in the event of serious disruptions. However, these policies come with a cost, which can increase overall supply chain

costs. Therefore, it is important to adopt an approach that balances these two extremes to increase supply chain performance to the desired level (Pettit et al., 2010). Despite efforts to make supply chains more flexible, the risk of disruption always exists. If the cost of mitigating this risk is too high, it may become unsustainable for organizations to continue their operations.

It is important for supply chains to be resilient in today's market conditions where customer requirements are unpredictable and variable. This requires a combination of strategic practices such as shortening lead times, developing advanced cooperation with flexible suppliers, and ensuring integration between chain members. In addition, buffer capacity and risk inventory should be integrated into supply chain strategies to ensure operational continuity and meet demand even in cases of interruption. The combination of reactive and proactive capabilities can enable the supply chain to quickly return to its normal flow in the face of possible problems and even improve its performance above the previous level (Ivanov, 2021). However, the level of performance and recovery time after disruption depends on the level of proactive and reactive capabilities of the chain, which can vary among organizations. Figure 1 provides a schematic representation of this process.

Although supply chains are organized in different structures by different organizations, they interact with each other. A disruption in a supply chain not only causes disruptions in the related chain but can also trigger disruptions in other supply chains that are connected to it. With the spillover effect, delivery delays may result in negative consequences such as loss of revenue, loss of market share and reputation, and loss of value in stocks (Hendricks & Singhal, 2005). Small disruptions in the supply chain can have significant consequences due to the spillover effect. Therefore, to increase supply chain resilience, it is important to carefully examine and monitor even minor interruptions (Dolgui et al., 2018), and enhance visibility throughout the supply chain (Ivanov, 2021).

Uninterrupted monitoring of flow in the supply chain increases visibility, allowing supply chain members to better deal with uncertainty (Ponomarov & Holcomb 2009). However, monitoring supply chains, which are becoming increasingly complex, is not an easy task. Technological innovations such as big data and the internet of things can make it easier to monitor supply chains, but their impact on improving supply chain resilience is limited. Supply chain transparency and collaboration, along with proactive management strategies, can significantly contribute to supply chain resilience by facilitating coping with interruptions (Gunasekaran et al., 2015).

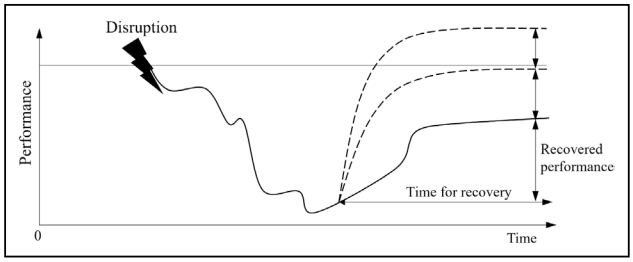

Figure 1. Recovery Process in Supply Chain Disruptions (Ivanov, 2021).

Supply chains are one of the main sources of business mobility and economic development. For this reason, disruptions that may occur in supply chains have the potential to affect not only the organizations in the relevant supply chains, but also the economy in which the supply chain is organized. Disruptions in supply chains can cause serious problems in the country's economy in the long run (Hendricks & Singhal, 2005). In addition, the uninterrupted meeting of the basic needs of the society in times of crisis depends on the durability of the supply chains. For this reason, supply chain resilience is of critical importance for the continuity of corporate and economic activities as well as the continuity of life. Likewise, in countries with durable supply chain networks, during periods of natural disasters such as earthquakes, floods, and fires, critically important vital products are delivered to the points where they are needed, and crises are managed more effectively (Ivanov, 2021).

2.1. Literature

Supply chain resilience is one of the topics that attract the attention of researchers working in the field of supply chain due to its increasing importance recently. In this context, researches on supply chain resilience and quantitative decision-making methods in national and international data sources have been scanned, prominent studies and issues related to these studies are given below.

Falasca et al. (2008) proposed a simulation-based framework in their study where they evaluated the resilience of supply chains against natural disasters. In their study, they concluded that density, complexity, and node criticality are determinants of supply chain resilience to natural disasters.

Soni et al. (2014) proposed a deterministic modeling in their study to measure supply chain resilience. They argued that this proposed model will enable managers to make comparisons between different supply chains, as well as to monitor the factors affecting supply chain resilience.

Timperio et al. (2016) used geographic information system and Fuzzy AHP methods in their study to determine the most appropriate facility location to ensure resilience in disaster relief supply chains. In their study, they emphasized the importance of the distribution center location for a supply chain network to be resilient enough to allow decision makers to carry out rescue operations as quickly as possible.

Wicher et al. (2016) used the Fuzzy ANP method in their research to measure resilience in metallurgical supply chains. Considering the criteria of cooperation, flexibility,

visibility, and financial strength, they argued that the measurement model they proposed, based on the findings they obtained as a result of the measurement, would be an effective tool in monitoring the resilience of the metallurgical supply chain.

Jafarnejad et al. (2019) used the Hesitant Fuzzy Delphi method in their study to investigate the main factors affecting the resilience of the medical equipment supply chain and to examine the dynamic relationships between these factors. As a result of their research, they concluded that ten main factors affect the supply chain resilience of medical equipment: agility, collaboration between supply chain actors, information sharing and trust, transparency of the supply chain, risk management culture, adaptability, structure, financing, and environmental conditions.

Rehman and Ali (2021) used Fuzzy AHP, Fuzzy TOPSIS and Fuzzy QFD methods in an integrated way in their work on prioritizing resilience strategies in health supply chains. As a result of their research, they revealed that Industry 4.0, multiple sourcing, risk awareness, agility and global diversification strategies are the most important strategies that increase resilience in healthcare supply chains.

Zhang et al. (2021) used Fuzzy AHP and Fuzzy TOPSIS methods together in their study where they examined the balance of resilience in the supply chains of cross-border e-commerce businesses. In line with their findings, they argued that resilience should be kept in an appropriate state of balance, rather than pursuing high resilience or low fragility.

Das et al. (2022) used AHP and DEMATEL methods in their studies on the effects of the Covid-19 outbreak on supply chain resilience. As a result of their research, they concluded that the most important factor in reducing the security vulnerabilities of the supply chain network is cost optimization, and government supports are the approach that can solve the problems that disturb the supply chains in the most effective way.

Belhadi et al. (2022) evaluated artificial intelligence applications used in strategies to increase supply chain resilience by integrating artificial neural networks and MCDM methods. From data collected from 479 manufacturing businesses, they suggested that fuzzy logic programming, machine learning big data, and agent-based systems are the best techniques to support strategies for supply chain resilience.

Wen and Liao (2022) proposed a new decision-making algorithm by integrating gained and lost dominance score method and personalized quantifiers with cubic spline interpolation in their study on the selection of policy recommendations to increase supply chain resilience under the effects of the Covid-19 epidemic. They demonstrated the superiority of the proposed algorithm with a sensitivity analysis and comparison analysis on a case study.

Banerjee et al. (2022) used the Gray DEMATEL method in their study to identify the barriers to building supply chain resilience in post-Covid-19 Indian SMEs and to explain the contextual relationship between them. As a result of their research, they concluded that lack of flexibility is the most critical causal barrier to building a resilient supply chain. They also drew attention to the lack of planning regarding resource management.

Pia et al. (2022) used Fuzzy ISM and DEMATEL methods in an integrated way in their study where they discussed the factors that determine supply chain resilience in the oil and natural gas industry during the Covid-19 epidemic. As a result of their research, they suggested that government support and security are the main drivers of supply chain resilience. They also concluded that collaboration and knowledge sharing among supply chain members are critical to supply chain resilience.

Hsu et al. (2022) used the MCDM and Quality House approach by integrating it in their study focusing on factors that increase supply chain resilience and reduce sustainable supply chain risks. In their application on one of China's largest relay manufacturers, they concluded that risks related to IT infrastructure and information system efficiency, customer supply disruptions, transportation disruptions, natural disasters and government instability were the most influential factors on supply chain resilience.

As it can be understood from the literature summary above, researches on supply chain resilience are carried out by focusing on businesses, and the general situation of countries is neglected. To contribute to filling this gap in the literature, this research focuses on supply chain resilience of N-11 countries. In this context, the methods used in the study are explained below.

3. METHODOLOGY

In this section, the data of N-11 countries on supply chain resilience, the methods used in the research and the reasons for choosing these methods are given.

The national aspect of supply chain resilience is an under-researched topic, and as a result, the FM Global Resilience Index is currently the only tool available to measure national supply chain resilience. Therefore, this index was utilized in this study. The evaluation process aimed to use current objective MCDM methods, for which MEREC, EDAS, MARCOS, and WASPAS methods were preferred. To mitigate any differences arising from the algorithms of these methods, the results obtained were combined using the BORDA Counting Method. The data and methods used in the research are discussed in detail below.

3.1. Data

Currently, there is no index or database that directly measures and evaluates the supply chain resilience of countries. Despite the lack of a direct index or database to measure and evaluate the supply chain resilience of countries,

FM Global, an international insurance company, offers a measurement tool known as the Resilience Index. This tool aims to demonstrate a country's resilience against unexpected and destructive events and comprises three dimensions: economic, risk quality, and supply chain. The supply chain dimension of the index in question is a measurement tool that demonstrates the resilience of the supply chains of countries. Therefore, the supply chain dimension of the FM Global Resilience Index was utilized in this research. In this context, Table 1 presents the FM Global Resilience Index indicators used to evaluate the supply chain resilience of N-11 countries and the codes assigned to these indicators (FM Global, 2022).

The FM Global Resilience Index measures the resilience of countries' supply chains by compiling data shared by the World Bank and the World Economic Forum. The indicators used in the measurement process can take values between 0 and 100. The scores of the N-11 countries, which are the subject of this research, regarding the supply chain resilience indicators are presented in Table 2.

The data presented in Table 2 were obtained from the 2022 report of the Global Resilience Index and were accepted as the basic dataset within the scope of the research.

3.2. Method

In this part of the research, the methods used in the evaluation of supply chain resilience of N-11 countries are discussed. During the evaluation process, the weights of the indicators were established using the MEREC method, while the supply chain resilience performances of the countries were assessed through three distinct approaches: EDAS, MARCOS, and WASPAS. Then, the rankings obtained from the application of these methods were combined with the BORDA Count Method to form the final ranking. Explanations about the methods used in the research are given below.

Table 1. Supply Chain Resilience Indicators and Codes

Indicators	Codes
Control of Corruption	C_1
Infrastructure Quality	C^2
Corporate Governance	C^3
Supply Chain Visibility	C^4
Supply Chain Timeliness	C^5

3.2.1. MEREC Method

MEREC Method, introduced to the literature by Keshavarz Ghorabaee et al. in 2021, is an objective criterion weighting method. In the process of determining the criterion weights, it takes advantage of the impact of each criterion on the overall performance of the alternatives (Şahin, 2022). The criterion that has the most significant effect on alternative performance is assigned the highest weight if removed. In this method, the effect of removing each criterion is determined by the absolute deviation, which is the difference between the overall performance of the alternative and its performance if the criterion is removed. This approach distinguishes MEREC from other weighting methods. The steps of the method are as follows (Keshavarz Ghorabaee et al., 2021).

Step 1: The decision matrix for the problem is created. This matrix represents the performance scores of n alternatives for m criteria and is expressed in the form of equation (1).

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1j} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2j} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & x_{i2} & \cdots & x_{ij} & \cdots & x_{im} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{ni} & \cdots & x_{nm} \end{bmatrix} \quad (1)$$

Step 2: To get rid of the effect of value range differences and criterion units, the decision matrix is normalized by means of equation (2). The new values obtained are between 0 and 1.

Table 2. N-11 Countries Indicator Scores on Supply Chain Resilience

N-11 Countries	Supply Chain Resilience Indicators				
	C_1	C_2	C_3	C_4	C_5
Bangladesh	35,3797	15,1938	47,0075	34,3163	37,3637
Egypt	67,3353	19,4906	64,3662	31,728	48,7696
Indonesia	59,5835	30,3565	65,6898	56,3081	68,7901
Iran	55,2474	12,3961	22,898	33,535	55,5691
Mexico	66,4529	18,6043	65,4598	43,7028	62,894
Nigeria	18,7105	12,0977	68,9604	30,0341	43,4584
Pakistan	41,8203	18,7951	69,0096	12,1302	26,3927
Philippines	45,1319	28,1575	48,2889	46,0242	39,8887
South Korea	95,1011	59,7367	83,0357	75,7002	79,3242
Türkiye	69,1152	31,8352	73,1571	53,4494	67,0442
Vietnam	56,9438	31,5238	46,7067	62,7041	68,8932

$$n_{ij}^{x} = \begin{cases} \dfrac{\min_k x_{kj}}{x_{ij}}; \ If\ cost\ criterion \\ \dfrac{x_{ij}}{max_k x_{kj}}; \ If\ benefit\ criterion \end{cases} \quad (2)$$

Step 3: The overall performances of the alternatives are calculated by equation (3). In the MEREC method, a logarithmic measure with equal criterion weights is applied to obtain the overall performances of the alternatives. This measure is based on a non-linear function.

$$S_i = ln\left(1 + \left(\frac{1}{m}\sum_j \left|ln\left(n_{ij}^{x}\right)\right|\right)\right) \quad (3)$$

Step 4: The performance values of the alternatives are calculated by using equation (4) for each criterion when removed. In this process, as in the previous step, a logarithmic measure is used.

$$S'_{ij} = ln\left(1 + \left(\frac{1}{m}\sum_{k,k\neq j} \left|ln\left(n_{ik}^{x}\right)\right|\right)\right) \quad (4)$$

Step 5: The sum of absolute deviations (E_j) for each criterion is calculated using equation (5). The obtained values show the removal effect of the criteria.

$$E_j = \sum_i \left|S'_{ij} - S_i\right| \quad (5)$$

Step 6: The final weight (w_j) of each criterion is calculated using equation (6), while considering the removal effect of the criteria.

$$w_j = \frac{E_j}{\sum_k E_k} \quad (6)$$

3.2.2. EDAS Method

EDAS Method is a method introduced to the literature by Keshavarz Ghorabaee et al. in 2015. This method evaluates by considering the distance from the mean solution (Keshavarz Ghorabaee et al., 2015). In this respect, it differs from other MCDM methods. It is particularly useful in situations where the characteristics of the alternatives conflict with each other (Alinezhad & Khalili, 2019).

In the EDAS method, there are two criteria: positive distance from the mean (PDA) and negative distance from the mean (NDA). High PDA value and low NDA value indicate that the alternative is better than the average solution (Karabasevic et al., 2018). In this context, it is desired that the alternatives evaluated have PDA values as high as possible and NDA values as low as possible. The steps for applying the method are as follows (Keshavarz Ghorabaee et al., 2015):

Step 1: The most important criteria that define the alternatives are determined. In this step, it is determined by which criteria the alternatives for the decision problem to be addressed will be evaluated.

Step 2: The decision matrix is created. The matrix illustrates the performance of n alternatives on m evaluation criteria and takes the form of equation (7).

$$X\left[X_{ij}\right]_{nxm} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \quad (7)$$

Step 3: The average solution matrix (AV) is created by considering all the criteria. This matrix is the average of the scores of the alternatives regarding the evaluation criteria and has the form of equality (8).

$$AV = \left[AV_j\right]_{1xm} \quad (8)$$

AV_j, represents the mean solution for each criterion and is calculated using equation (9).

$$AV_j = \frac{\sum_{i=1}^{n} X_{ij}}{n} \quad (9)$$

Step 4: A matrix of positive distance from the mean (PDA) and a matrix of negative distance from the mean (NDA) are formed. These matrices have the form of equality (10) and equation (11), respectively.

$$PDA = \left[PDA_{ij}\right]_{nxm} \quad (10)$$

$$NDA = \left[NDA_{ij}\right]_{nxm} \quad (11)$$

PDA_{ij}, shows the positive distance of the ith alternative from the mean solution for the jth criterion. It is calculated using equation (12) if the criterion j is benefit-based, and equation (13) if it is cost-based. Similarly, NDA_{ij} shows the negative distance of the i-th alternative from the mean solution for criterion j. It is calculated using equation (14) if the criterion j is benefit-based, and equation (15) if it is cost-based.

$$PDA_{ij} = \frac{\max\left(0, \left(X_{ij} - AV_j\right)\right)}{AV_j} \quad (12)$$

$$PDA_{ij} = \frac{\max\left(0, \left(AV_j - X_{ij}\right)\right)}{AV_j} \quad (13)$$

$$NDA_{ij} = \frac{\max\left(0, \left(AV_j - X_{ij}\right)\right)}{AV_j} \quad (14)$$

$$NDA_{ij} = \frac{\max\left(0, \left(X_{ij} - AV_j\right)\right)}{AV_j} \quad (15)$$

Step 5: The predetermined criterion weight values (wj) for each alternative are considered and the weighted total positive distance value (SP_i) is calculated using equation (16) and the weighted total negative distance value (SN_i) is calculated using equation (17).

$$SP_i = \sum_{i=1}^{m} w_j PDA_{ij} \quad (16)$$

$$SN_i = \sum_{i=1}^{m} w_j NDA_{ij} \quad (17)$$

Step 6: NSP_i and NSN_i values are calculated by normalizing the SP_i and SN_i values of the alternatives using the equations (18) and (19).

$$NSP_i = \frac{SP_i}{max_i(SP_i)} \quad (18)$$

$$NSN_i = 1 - \frac{SN_i}{max_i(SN_i)} \quad (19)$$

Step 7: Appraisal score (AS) for all alternatives are calculated using equation (20). The calculated AS values range from 0 to 1.

$$AS_i = \frac{1}{2}\left(NSP_i + NSN_i\right) \quad (20)$$

Step 8: Alternatives are ranked according to their AS values from largest to smallest. The alternative with the highest AS value is considered as the best alternative.

3.2.3. MARCOS Method

MARCOS method was developed in 2020 by Stević et al. as an objective MCDM method based on defining the relationship between alternatives and reference values. In the MARCOS method, a consensus ranking is created by determining the positions of the alternatives according to the ideal and anti-ideal solutions (Çınaroğlu, 2021). The best alternative is determined as the one that is closest to the ideal solution and farthest from the anti-ideal solution (Şahin, 2022). The solution steps of the MARCOS method are as follows (Stević et al., 2020):

Step 1: An initial decision matrix is created showing the performance of m alternatives for the decision problem in terms of n evaluation criteria.

Step 2: The expanded initial matrix is created by defining the ideal and anti-ideal solutions. This matrix is the initial decision matrix with the ideal (AI) and anti-ideal (AAI) solution rows added. The matrix structure is represented by equation (21).

$$X = \begin{matrix} AAI \\ A_1 \\ A_2 \\ \cdots \\ A_m \\ AI \end{matrix} \begin{bmatrix} x_{aa1} & x_{aa2} & \cdots & x_{aan} \\ x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \\ x_{ai1} & x_{ai2} & \cdots & x_{ain} \end{bmatrix} \quad (21)$$

The AI and AAI solutions added to the matrix are calculated using equations 22 and 23, depending on whether the criteria are benefit (B) or cost (C) features.

$$AAI = min_i x_{ij} \text{ if } j \in B \text{ and } max_i x_{ij} \text{ if } j \in C \quad (22)$$

$$AI = max_i x_{ij} \text{ if } j \in B \text{ and } min_i x_{ij} \text{ if } j \in C \quad (23)$$

Step 3: The expanded initial matrix is normalized using equations (24) and (25), which depend on the characteristics of the criteria being evaluated.

$$n_{ij} = \frac{x_{ai}}{x_{ij}} \text{ eğer } j \in C \quad (24)$$

$$n_{ij} = \frac{x_{ij}}{x_{ai}} \text{ eğer } j \in B \quad (25)$$

where elements x_{ij} and x_{ai} represent the elements of the matrix X.

Step 4: Using equation (26), the weighted matrix $V=[v_{ij}]_{m\times n}$ is created.

$$v_{ij} = n_{ij} \times w_j \quad (26)$$

Step 5: The utility degree of the alternatives (K_i) is calculated. During this process, equation (27) is used for the distances of the alternatives from the anti-ideal solution, and equation (28) is used for the distances from the ideal solution.

$$K_i^- = \frac{S_i}{S_{aai}} \quad (27)$$

$$K_i^+ = \frac{S_i}{S_{ai}} \quad (28)$$

Where S_i (i=1,2,…,m) represents the sum of the weighted matrix V elements, which is calculated using equation (29).

$$S_i = \sum_{i=1}^{n} v_{ij} \quad (29)$$

Step 6: The utility function ($f(K_i)$), which determines the distances of the alternatives from the ideal and anti-ideal solution, is calculated using equation (30).

$$f(K_i) = \frac{K_i^- + K_i^+}{1 + \frac{1 - f(K_i^+)}{f(K_i^+)} + \frac{1 - f(K_i^-)}{f(K_i^-)}} \quad (30)$$

Where $f(K_i^-)$ represents the utility function according to the anti-ideal solution and is determined using equation (31). Similarly, $f(K_i^+)$ represents the utility function according to the ideal solution and is determined by means of equation (32).

$$f(K_i^-) = \frac{K_i^+}{K_i^+ + K_i^-} \quad (31)$$

$$f(K_i^+) = \frac{K_i^-}{K_i^+ + K_i^-} \quad (32)$$

Step 7: The alternatives are ranked based on the values of their utility functions. The alternative with the highest utility function value is considered the most suitable alternative.

3.2.4. WASPAS Method

The WASPAS method is an MCDM method that performs alternative ordering of decision problems by combining the Weighted Sum and Weighted Product methods. The method, developed by Zavadskas et al. in 2012, has been widely used in the literature for solving various decision problems. The WASPAS method aims to achieve a high level of consistency by optimizing the weighted integrated function (Lashgari et al., 2014). The solution steps of the method are as follows (Zavadskas et al., 2012):

Step 1: A decision matrix is created, which shows the performance of m alternatives in terms of n evaluation criteria and is represented in the form of equation (33).

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (33)$$

Step 2: The decision matrix is normalized. During this process, equation (34) is used for benefit criteria and equation (35) is used for cost criteria. The new matrix to be obtained is in the form of equation (36).

$$\overline{x}_{ij} = \frac{x_{ij}}{max_i x_{ij}} \quad (34)$$

$$\overline{x}_{ij} = \frac{min_i x_{ij}}{x_{ij}} \quad (35)$$

$$\overline{X} = \begin{bmatrix} \overline{x}_{11} & \overline{x}_{12} & \cdots & \overline{x}_{1n} \\ \overline{x}_{21} & \overline{x}_{22} & \cdots & \overline{x}_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \overline{x}_{m1} & \overline{x}_{m2} & \cdots & \overline{x}_{mn} \end{bmatrix} \quad (36)$$

Step 3: Evaluation score is calculated for each ith alternative using the weighted sum method. This is done using equation (37).

$$Q_i^{(1)} = \sum_{j=1}^{n} \bar{x}_{ij} \times w_j \quad (37)$$

where, w_j shows the weight value of the j criterion, and $Q_i^{(1)}$ shows the evaluation score calculated according to the weighted sum method of the ith alternative.

Step 4: Evaluation score is calculated for each ith alternative using the weighted product method. This is done using equation (38).

$$Q_i^{(2)} = \prod_{j=1}^{n} \bar{x}_{ij}^{w_j} \quad (38)$$

Step 5: The weighted common criterion value(Q_i) of each alternative is calculated by combining the evaluation scores calculated with the weighted sum and weighted product methods. This operation is performed using equation (39). The alternative with the highest Q_i value is the best alternative.

$$Q_i = 0{,}5Q_i^{(1)} + 0{,}5Q_i^{(2)} = \left[0{,}5 \times \left(\sum_{j=1}^{n} \bar{x}_{ij} \times w_j\right)\right] + \left[0{,}5 \times \left(\prod_{j=1}^{n} \bar{x}_{ij}^{w_j}\right)\right] \quad (39)$$

Equation 40 is used when it is not desired to give equal importance to weighted sum and weighted multiplication methods in the integration process.

$$Q_i = \lambda Q_i^{(1)} + (1-\lambda)Q_i^{(2)} = \left[\lambda \times \left(\sum_{j=1}^{n} \bar{x}_{ij} \times w_j\right)\right] + (1-\lambda)\left[0{,}5 \times \left(\prod_{j=1}^{n} \bar{x}_{ij}^{w_j}\right)\right] \quad (40)$$

where λ can take a value between 0 and 1 and this value is determined by the decision maker. If it is 0, the evaluation process turns into the weighted product method, and if it is 1, it turns into the weighted sum method.

3.2.5. BORDA Count Method

The BORDA count method is a method that combines two or more ranking lists to form a single ranking list. In this method, the scores are determined by assigning zero points to the least preferred alternative by the decision maker, one point to the next most preferred alternative, and so on up to n-1 points to the most preferred alternative. Then, the BORDA scores of all the ranking lists of the alternatives are summed and the final BORDA scores of the alternatives are calculated. (Lansdowne & Woodward, 1996). As a result of the calculation, the alternative with the highest final BORDA value is the best alternative.

4. APPLICATION AND RESULTS

In the first stage of the evaluation process, the weights of the indicators related to the resilience of the supply chain were determined using the MEREC method. Firstly, a decision matrix with the form of equality (1) was created by using the scores of N-11 countries in Table 2 related to the durability of the supply chain. Then, the created decision matrix was normalized using equation (2), and Table 3 was obtained.

The solution steps of the MEREC method were continued after normalizing the decision matrix. The overall performance scores of the alternatives were calculated using equation (3). Then, the performance scores of the alternatives were calculated if each criterion was removed using equation (4). The results of these calculations are presented in Table 4.

The MEREC method calculates the criteria weights by considering the changes that would occur in the performance scores of the alternatives if the criteria were removed. In this context, the absolute deviation (E_j) values of the criteria were calculated using equation (5), and the weights (w_j) of the criteria were calculated using equation (6), considering the scores in Table 4. The results of the calculations are given in Table 5.

As can be seen from Table 5, according to the MEREC method, supply chain resilience in N-11 countries is most affected by the C4 coded Supply Chain Visibility criterion and the C3 coded Corporate Governance criterion. This indicates that the highest difference in supply chain resilience indicators among N-11 countries occurs among these criteria.

In the second stage of the evaluation process, the EDAS method was used to rank N-11 countries according to their supply chain resilience performance. Firstly, in this context, average solutions for each criterion were obtained using

Table 3. MEREC Normalized Decision Matrix

N-11 Countries	C_1	C_2	C_3	C_4	C_5
Bangladesh	0,5288	0,7962	0,4871	0,3535	0,7064
Egypt	0,2779	0,6207	0,3557	0,3823	0,5412
Indonesia	0,3140	0,3985	0,3486	0,2154	0,3837
Iran	0,3387	0,9759	1,0000	0,3617	0,4750
Mexico	0,2816	0,6503	0,3498	0,2776	0,4196
Nigeria	1,0000	1,0000	0,3320	0,4039	0,6073
Pakistan	0,4474	0,6437	0,3318	1,0000	1,0000
Philippines	0,4146	0,4296	0,4742	0,2636	0,6617
South Korea	0,1967	0,2025	0,2758	0,1602	0,3327
Türkiye	0,2707	0,3800	0,3130	0,2269	0,3937
Vietnam	0,3286	0,3838	0,4903	0,1935	0,3831

Table 4. Performance Scores of Alternatives If Criteria Are Removed

N-11 Countries	C_1	C_2	C_3	C_4	C_5
Bangladesh	1,1482	1,1738	1,009	0,8847	1,1361
Egypt	1,3095	1,352	1,1965	1,2181	1,3159
Indonesia	1,5541	1,5642	1,5357	1,4264	1,5562
Iran	1,0175	1,0912	1,0994	0,6859	0,8144
Mexico	1,4555	1,4938	1,3439	1,2817	1,3903
Nigeria	1,255	1,255	0,8777	0,956	1,1016
Pakistan	0,7845	0,8172	0,4709	0,995	0,995
Philippines	1,2979	1,2998	1,3264	1,1569	1,4111
South Korea	1,7118	1,7129	1,7671	1,6697	1,7986
Türkiye	1,5624	1,5765	1,5356	1,4639	1,5838
Vietnam	1,5055	1,5124	1,565	1,3488	1,512

Table 5. Absolute Deviations and Weights of Criteria

Results	C_1	C_2	C_3	C_4	C_5
E_j	1,7196	1,4728	2,5945	3,2349	1,7067
w_j	0,1603	0,1373	0,2418	0,3015	0,1591

equation (9) based on the data presented in Table 2. Then, by applying equation (10) and equation (12), the positive distance matrix in Table 6 was obtained.

The values in Table 6 also indicate whether the performance scores of N-11 countries on the relevant criteria are above the average. Distance scores of countries with criterion performance below the average in the positive distance matrix take the value 0. In this context, Bangladesh is a country that falls below the average in all criteria among the N-11 countries.

The EDAS method ranks alternatives by considering both their positive and negative distances from the mean solution. In this regard, the negative distances of the alternatives to the mean solution were calculated using equations (11) and (13), and the negative distance matrix in Table 7 was obtained.

The next step of the evaluation process using the EDAS method is to calculate the weighted total distance scores. The weighted positive total distance values of the N-11 countries were calculated using equation (16), and the weighted negative total distance values were calculated using equation (17), considering the criteria weights obtained by the MEREC method. The obtained values were then normalized using equations (18) and (19), respectively. Finally, the N-11 countries were ranked using equation (20), and the application of the EDAS method was completed. The results obtained from these calculations and the ranking of the countries according to the EDAS method are presented in Table 8.

In the next phase of the evaluation process, N-11 countries' performance on supply chain resilience was analyzed using the MARCOS method. According to the solution steps of the MARCOS method, firstly, an expanded initial

Table 6. Positive Distance Matrix

N-11 Countries	C_1	C_2	C_3	C_4	C_5
Bangladesh	0,0000	0,0000	0,0000	0,0000	0,0000
Egypt	0,2126	0,0000	0,0817	0,0000	0,0000
Indonesia	0,0730	0,2003	0,1039	0,2914	0,2645
Iran	0,0000	0,0000	0,0000	0,0000	0,0215
Mexico	0,1967	0,0000	0,1000	0,0023	0,1562
Nigeria	0,0000	0,0000	0,1589	0,0000	0,0000
Pakistan	0,0000	0,0000	0,1597	0,0000	0,0000
Philippines	0,0000	0,1134	0,0000	0,0555	0,0000
South Korea	0,7126	1,3621	0,3954	0,7361	0,4582
Türkiye	0,2447	0,2588	0,2294	0,2258	0,2325
Vietnam	0,0255	0,2465	0,0000	0,4381	0,2664

Table 7. Negative Distance Matrix

N-11 Countries	C_1	C_2	C_3	C_4	C_5
Bangladesh	0,3629	0,3992	0,2101	0,2130	0,3132
Egypt	0,0000	0,2293	0,0000	0,2723	0,1035
Indonesia	0,0000	0,0000	0,0000	0,0000	0,0000
Iran	0,0051	0,5098	0,6152	0,2309	0,0000
Mexico	0,0000	0,2644	0,0000	0,0000	0,0000
Nigeria	0,6631	0,5216	0,0000	0,3112	0,2011
Pakistan	0,2469	0,2568	0,0000	0,7218	0,5148
Philippines	0,1872	0,0000	0,1885	0,0000	0,2667
South Korea	0,0000	0,0000	0,0000	0,0000	0,0000
Türkiye	0,0000	0,0000	0,0000	0,0000	0,0000
Vietnam	0,0000	0,0000	0,2151	0,0000	0,0000

Table 8. Scores and Ranks of N-11 Countries Obtained by the EDAS Method

N-11 Countries	SP_i	SN_i	NSP_i	NSN_i	AS_i	Rank
Bangladesh	0,0000	0,2778	0,0000	0,2579	0,1290	8
Egypt	0,0538	0,1301	0,0778	0,6526	0,3652	7
Indonesia	0,1943	0,0000	0,2809	1,0000	0,6404	3
Iran	0,0034	0,2892	0,0049	0,2275	0,1162	10
Mexico	0,0813	0,0363	0,1175	0,9031	0,5103	5
Nigeria	0,0384	0,3037	0,0555	0,1887	0,1221	9
Pakistan	0,0386	0,3744	0,0558	0,0000	0,0279	11
Philippines	0,0323	0,1180	0,0467	0,6847	0,3657	6
South Korea	0,6917	0,0000	1,0000	1,0000	1,0000	1
Türkiye	0,2353	0,0000	0,3402	1,0000	0,6701	2
Vietnam	0,2124	0,0520	0,3071	0,8610	0,5841	4

Table 9. Initial Decision-Making Matrix

N-11 Countries	C_1	C_2	C_3	C_4	C_5
AAI	18,7105	12,0977	22,8980	12,1302	26,3927
Bangladesh	35,3797	15,1938	47,0075	34,3163	37,3637
Egypt	67,3353	19,4906	64,3662	31,728	48,7696
Indonesia	59,5835	30,3565	65,6898	56,3081	68,7901
Iran	55,2474	12,3961	22,898	33,535	55,5691
Mexico	66,4529	18,6043	65,4598	43,7028	62,894
Nigeria	18,7105	12,0977	68,9604	30,0341	43,4584
Pakistan	41,8203	18,7951	69,0096	12,1302	26,3927
Philippines	45,1319	28,1575	48,2889	46,0242	39,8887
South Korea	95,1011	59,7367	83,0357	75,7002	79,3242
Türkiye	69,1152	31,8352	73,1571	53,4494	67,0442
Vietnam	56,9438	31,5238	46,7067	62,7041	68,8932
AI	95,1011	59,7367	83,0357	75,7002	79,3242

decision-making matrix was created by using equation (22) and equation (23), considering the data in Table 2. The resulting matrix is presented in Table 9.

In the next step of the evaluation process using the MARCOS method, the matrix in Table 9 was normalized using equality (25), and a weighted normalized decision

Table 10. N-11 Countries Scores and Ranks for the MARCOS Method

N-11 Countries	S_i	K_i^-	K_i^+	$f(K_i^-)$	$f(K_i^+)$	$f(K_i)$	Rank
Bangladesh	0,4431	1,9495	0,4431	0,1852	0,8148	1,3518	9
Egypt	0,5699	2,5077	0,5699	0,1852	0,8148	2,6683	3
Indonesia	0,7237	3,1845	0,7237	0,1852	0,8148	5,6173	7
Iran	0,4333	1,9066	0,4333	0,1852	0,8148	1,2770	1
Mexico	0,6456	2,8407	0,6456	0,1852	0,8148	3,8695	10
Nigeria	0,4670	2,0546	0,4670	0,1852	0,8148	1,5487	5
Pakistan	0,4159	1,8300	0,4159	0,1852	0,8148	1,1513	6
Philippines	0,5447	2,3968	0,5447	0,1852	0,8148	2,3476	8
South Korea	1,0000	4,4001	1,0000	0,1852	0,8148	23,7607	11
Türkiye	0,7501	3,3003	0,7501	0,1852	0,8148	6,3662	2
Vietnam	0,6924	3,0465	0,6924	0,1852	0,8148	4,8394	4

matrix was then created using equality (26). The distances of the N-11 countries from the anti-ideal solution were found using equation (27), and their distances from the ideal solution were calculated using equation (28). Finally, using equation (30), the values of the countries' utility functions were determined, and their rankings were established. The results of the calculations and the rankings of the N-11 countries according to the MARCOS method are presented in Table 10.

In the fourth stage of the evaluation process, the performance of the N-11 countries regarding supply chain resilience was analyzed using the WASPAS method. Firstly, a decision matrix was created by considering the data in Table 2, and then it was normalized using the matrix formed by equation (34). Next, the evaluation scores of the N-11 countries were calculated using the weighted sum and weighted multiplication methods, based on equations (37) and (38). Finally, since these two evaluation methods were deemed equally important, the weighted common criterion values of the N-11 countries were calculated using equation (39), and the countries were ranked based on the obtained values. The results of the calculations and the rankings of the N-11 countries are presented in Table 11.

Table 11. N-11 Countries Scores and Ranks for the WASPAS Method

N-11 Countries	$Q_i^{(1)}$	$Q_i^{(2)}$	Q_i	Rank
Bangladesh	0,4431	0,1210	0,2820	9
Egypt	0,5699	0,1526	0,3612	6
Indonesia	0,7237	0,2006	0,4622	3
Iran	0,4333	0,1123	0,2728	10
Mexico	0,6456	0,1742	0,4099	5
Nigeria	0,4670	0,1143	0,2906	8
Pakistan	0,4159	0,0971	0,2565	11
Philippines	0,5447	0,1521	0,3484	7
South Korea	1,0000	0,2809	0,6404	1
Türkiye	0,7501	0,2081	0,4791	2
Vietnam	0,6924	0,1905	0,4414	4

At the last stage of the evaluation process, the rankings of N-11 countries obtained by the EDAS, MARCOS and WASPAS method were combined with the BORDA method to obtain the final ranking in Table 12.

As seen in Table 12, South Korea ranked as the best N-11 country in terms of supply chain resilience within the scope of the research, followed by Türkiye and Indonesia, respectively. Furthermore, Pakistan, Iran, and Bangladesh ranked as the countries with the lowest supply chain resilience among the N-11 countries.

5. CONCLUSION

Supply chains are organizations in which many actors with different positions and characteristics have to work together. This situation causes supply chains to take on a complex structure and face many risk factors. In addition, a malfunction that may occur at any point in the chain due to the interdependence of the chain actors can spread to the entire chain and cause devastating results. For this reason, it is of

Table 12. N-11 Countries Final Ranks

N-11 Countries	Score	Rank
Bangladesh	7	9
Egypt	14	6
Indonesia	24	3
Iran	3	10
Mexico	18	5
Nigeria	8	8
Pakistan	0	11
Philippines	13	7
South Korea	30	1
Türkiye	27	2
Vietnam	21	4

great importance to maintain uninterrupted flow of semi-finished products and finished products in supply chains.

The continuity of the semi-finished and finished product flow in the supply chains, despite all the uncertainties and disruptions, depends on the circularity of the supply chain. Making a supply chain resilient and sustaining this resilience require a combination of strategic practices such as shortening lead times, establishing advanced cooperation with flexible suppliers, closely monitoring the flow in the chain, and improving the integration between supply chain actors. Although these practices have the effect of increasing supply chain resilience, the dynamics of the region where supply chain activities are carried out play an active role in increasing resilience to a high level and making it permanent. Therefore, supply chain managers should closely monitor the dynamics of the regions where the chain spans.

Supply chain resilience is of critical importance not only for chain actors but also for national economies. Non-resistive supply chains can trigger major disruptions because of unexpected disruptions, causing loss of workforce and economic problems. In addition, countries with non-resilient supply chain networks have difficulties in attracting investors. Therefore, just like supply chain managers, policy makers should monitor the resilience of the supply chains in their countries and even develop policies and practices to increase supply chain resilience.

Although supply chain resilience is a crucial issue for both chain actors and policymakers, it is often dealt with on an enterprise level, and its national aspect is overlooked. The literature review reveals that scientific studies are mostly focused on specific businesses or sectors and explore the factors that affect supply chain resilience. Therefore, in this study, supply chain resilience has been tried to contribute to the literature by considering country-based. In this context, supply chain resilience in N-11 countries, which have the potential to be the supply centers of the future due to their resources and socioeconomic characteristics, has been examined.

In this study, the MEREC, EDAS, MARCOS, and WASPAS methods were integrated and used based on the Global Resilience Index data published by FM Global. Firstly, the MEREC method was used to determine the weights of the indicators that affect the supply chain resilience of the countries. Then, the EDAS, MARCOS, and WASPAS methods were used separately to determine the rankings of the countries based on their supply chain resilience. Finally, the BORDA counting method was used to combine the final rankings and form the overall rankings of the N-11 countries. This approach attempted to fill the gap in the literature on supply chain resilience by considering it on a country basis, and also aimed to enrich the decision-making literature by integrating four different MCDM methods.

The calculations carried out to determine the indicator weights with the MEREC method revealed that the Supply Chain Visibility and Corporate Governance indicators are the most significant factors affecting supply chain resilience in N-11 countries. These findings suggest that the indicators identified by Jafarnejad et al. (2019) can also be utilized to evaluate national supply chain resilience. Moreover, it is clear that investing in supply chain visibility and corporate governance will lead to significant improvements in supply chain resilience. Whence, organizations with supply chain operations in N-11 countries are expected to become more competitive if they adopt institutionalization approaches and closely monitor supply chain flows. However, it should not be overlooked that spending excessively to increase supply chain resilience may cause harm instead of benefit. Therefore, it is recommended to maintain a balance in resilience, as advocated by Zhang et al (2021). In this regard, it is thought that state supports will be an important factor in establishing this balance, as in the suggestions of Das et al. (2022).

Similar results were obtained in the assessments of supply chain resilience in N-11 countries using the EDAS, MARCOS, and WASPAS methods. South Korea ranked first, followed by Türkiye in second place, and Indonesia in third place in each of the calculations made with the three methods. Additionally, Pakistan and Iran ranked last in the findings of the three methods. Although there were minor ranking differences in other countries, the fact that the methods with different calculation algorithms mostly give similar results indicates the high reliability of the evaluation. However, due to slight differences in the three different methods, the results of the ranking were combined with the BORDA counting method to create a more reliable final ranking. Considering the final ranks, it can be understood that South Korea and Türkiye have a very good position among the N-11 countries in terms of supply chain durability. This situation is thought to allow Türkiye to host more supply chain operations in the future. Nevertheless, it is crucial for Türkiye to continue to develop policies and practices to protect this potential, as the economic conjuncture is constantly changing, and the world is witnessing events that may cause new disruptions every day in an increasingly globalized and intensifying competitive environment. Increasing transportation costs cause supply chains to be fragmented and organized with local sub-chains, while scarce resources force supply chains to work with more efficient operations. Therefore, providing and maintaining resilience in supply chains is becoming increasingly difficult and requires additional applications. This situation demonstrates similarities at both the national and business levels. As a matter of fact, Ponomarov and Holcomb (2009) emphasized in their research on businesses that it is necessary to continuously develop talents to make the supply chain more resilient. For this reason, policymakers should continue to provide the necessary infrastructure and technology for supply chains to become more durable throughout the country and develop policies that will make their supply chains more functional.

6. LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

The study's findings are limited to the N-11 countries and may not necessarily be applicable to other countries or regions. Therefore, if the number of countries studied changes, different results may be obtained. Nevertheless, the methodology used in this study can be applied to other countries or regions to evaluate their supply chain resilience.

The most important limitation of the study is the data used in the evaluation. Because the Global Resilience Index data published by FM Global, which is the only data source on national supply chain resilience, was used in this study. This limitation can be removed with the measurement tools to be developed to measure the resilience of the National Supply Chain. Another limitation of the research is the solution algorithms of the methods used. Although five different methods were used together in the evaluation process to increase reliability, the algorithms of the methods have limitations. These limitations can be reduced by using new methods to be developed.

Supply chain resilience of different countries and country groups can be addressed in future research, and different methods can be used in evaluation processes. In addition, indicators for determining supply chain resilience can be developed, empirical studies can be carried out, and the impact of supply chain resilience on national economies can be examined.

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The effects of Intrapreneurship Tendencies on Social Innovation in Organizations: A Practice on Employees in Cooling-Heating Sector in Istanbul Türkiye

Kurum İçi Girişimcilik Eğilimlerinin Sosyal İnovasyona Etkileri Kuruluşlar: Soğutma-Isıtma Sektöründe Çalışanlar Üzerine Bir Uygulama İstanbul Türkiye

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ABSTRACT

The purpose of the study is to determine the effects of the entrepreneurship tendency of organizational employees on social innovation. A quantitative study is conducted with participants working in the cooling-heating sector in Istanbul. Survey technique is used for 390 individuals of the sample. In the current study, data collected from the managers in establishments for workers is analyzed using SPSS 23 package software. Reliability analysis of the data is conducted through the Cronbach Alpha coefficient. Skew and kurtosis values are analyzed to determine whether data in sub-dimensions are in the normal distribution. Data transformation is conducted by drawing squares for "Social Innovation" variance that did not distribute normally. Unpaired T-Test and One-Way Variance Analysis (ANOVA) are performed to determine whether Entrepreneurship Scale and Social Innovation Scale show significance in relation to demographic variables. Results show that there is a significance between all variables -except demographic gender- and the dimensions of entrepreneurship. There is a positive significance between social innovation level and entrepreneurship level. In other words, as the creativity level of employees and workers increases their entrepreneurship level rises.

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ÖZ

Araştırmanın amacı, örgütsel çalışanların girişimcilik eğilimlerinin sosyal inovasyon üzerindeki etkilerini belirlemektir. İstanbul'da soğutma-ısıtma sektöründe çalışan katılımcılarla nicel bir araştırma yapılmıştır. Örneklemin 390 bireyi için anket tekniği kullanılmıştır. Bu çalışma-

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da, işletmelerde çalışanlar için yöneticilerden toplanan veriler SPSS 23 paket yazılımı kullanılarak analiz edilmiştir. Verilerin güvenirlik analizi Cronbach Alpha katsayısı ile yapılmıştır. Alt boyutlardaki verilerin normal dağılımda olup olmadığını belirlemek için çarpıklık ve basıklık değerleri analiz edilmiştir. Normal dağılmayan "Sosyal İnovasyon" varyansı için kareler çizilerek veri dönüşümü yapılır. Girişimcilik Ölçeği ve Sosyal İnovasyon Ölçeğinin demografik değişkenlere göre anlamlılık gösterip göstermediğini belirlemek için Unpaired T-Testi ve Tek Yönlü Varyans Analizi (ANOVA) yapılmıştır. Sonuçlar, demografik cinsiyet dışındaki tüm değişkenler ile girişimciliğin boyutları arasında anlamlılık olduğunu göstermektedir. Sosyal inovasyon düzeyi ile girişimcilik düzeyi arasında pozitif bir anlamlılık vardır. Diğer bir deyişle, çalışanların ve çalışanların yaratıcılık düzeyi arttıkça girişimcilik düzeyleri de yükselmektedir.

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1. INTRODUCTION

All establishments have to survive in the present economy in order to maintain their survival in the world. Developments in the world all together have impacts on this survival process. The establishments that can renew, change or develop themselves are more likely to survive, which is only possible with entrepreneurship and social innovations.

Regardless of how those two concepts mentioned before seem to be different and independent from each other, experts in both groups are of creative and innovative character. Entrepreneurs make all necessary innovations where they work whereas social innovation experts attempt to remove off the communal barriers before these innovations (Agca and Buyukaslan, 2016).

The first actions in innovation, a function of entrepreneurship, took place in the socio-cultural leg. However, the focus of practices shifted to a point of view toward the economy and community as time passed. Due to failures and communal problems in previous economies, it is inevitable to consider these two events as a whole.

1.1. Entrepreneurship: Definition

In the most general sense, entrepreneurship is starting a business for profit by taking risks, which remains at the forefront of the world and is a dynamic that is blended with technology. Having harsh working conditions and thoughts of earning more money, workers are encouraged to make new attempts.

There has been complexity in the definition of entrepreneurship since some individuals are more able to observe or create new opportunities while some are more successful in realizing their ideas and dreams than others (Arikan, 2004).

Reviewing the studies on entrepreneurship, it is seen there is a conflict between the concepts of management and entrepreneurship. Upon investigating entrepreneur models, individuals are seen to be going on an independent, short-term, dynamic, and opportunist path. It is normal for them to behave professionally within the establishment they started and run during growth. In this sense, they are of Professional characteristics rather than any managers (Berber, 2000).

Another dynamic that is studied with entrepreneurship is leadership. The general sense is that entrepreneurs must be leaders. The leadership characteristics that entrepreneurs have is seen to be one of the most significant factors for executive success. The responsibility of a manager is defined as directing all people in an establishment toward the same vision, motivating and supporting them for success (Arikan, 2002).

Establishments are much trying to be more corporate in the present global world system. As a result of increasing attempts in terms of entrepreneurship in establishments, competition within a market has risen (Cetindamar and Fis, 2007). Establishments have developed two separate theories as "establishment entrepreneurship" and "corporate entrepreneurship" for defining entrepreneur behaviors (Alpkan et al. 2005; Danisman and Erkocaoglan, 2007). The goal of corporate entrepreneurship is to benefit from opportunities in fast-changing markets, create a dynamic competitive atmosphere, maintain an innovative and competitive organizational structure, and be flexible (Covin and Covin, 1990).

Having lots of definitions, entrepreneurship is defined as the actions of individuals having entrepreneurial qualities in an establishment by Drucker and as the individuals who take responsibility implement any ideas in an establishment by Pinchot (Sharma and Chrisman, 1999; Agca and Yoruk, 2006). Differently, Markoysa (2008: 374) defined intrapreneurship as those who are energetic, creative, risk-taking, flexible, and innovative characteristics. Taking all these into consideration, it would be possible to define intrapreneurship as helping an establishment to compete in the related sector by one who has or must have the qualities of an entrepreneur and his or her behaviors of taking risks to increase profits.

Entrepreneurs enable any candidates of entrepreneurial characteristics in an establishment. Those who are discovered by work and organization networks and particularly

previous entrepreneurs are defined as entrepreneurs. When viewed from this aspect, the first entrepreneurs seem to be a catalyzer, who take responsibilities with the new entrepreneurs and then fade themselves to make new ones independent.

1.2. Entrepreneurship: Dimensions

Making Changes/Innovation: The process of creating new products, services, processes, Technologies, and methods (Lumpkin and Dess 1996).

Risk Taking: Despite the possibility to lose, deciding on investment and taking strategic actions to evaluate new opportunities in an atmosphere of uncertainty (Lumpkin and Dess 1996-2001).

Pro activeness: Top management's and establishment's tendency to be a leader and to make new attempts (Lumpkin and Dess 1996-2001).

Autonomy: Independence that an individual, group, or establishment shows during expressing an idea or a vision (Lumpking and Dess, 1996).

Starting a New Business: Creating new products, works, and new autonomous units or semi-autonomous firms in the present establishment (Antoncic and Hisrich, 2001-2003).

Self-Renewal/Strategical Renewal: Re-formulating the goals and strategies, re-defining work concepts, and re-organizational and organizational change (Antoncic, 2000).

Competitive Initiative: Positioning toward the rivals or challenging them in the market directly and intensely (Lumpkin and Dess, 1996; Antoncic, 2000).

1.3. Innovation: Definition

Innovation is defined as implementing products, new marketing styles, organizational management or processes, which are considerably developed, in in-establishment practices, establishments or external affairs (Yavuz, 2000).

1.3.1. Social Innovation

Social innovation is defined as creating innovative solutions to cultural, economic, communal, and environmental problems and implementing them in real life for people, the community, and the planet themselves. Lots of social entrepreneurs today benefit from social innovations for solutions to present problems that people face. Thanks to social innovation, solutions are possible for such problems as lack of energy and resources, economic crisis, poverty, discrimination, health problems, educational problems, and demographic instabilities (Özdemir and Ar, 2015).

2. METHOD

The study employed general survey model based on quantitative data. The universe is the individuals living in İstanbul city while the sample consisted of 390 individuals randomly chosen and volunteered in participating in the study. The study is limited to İstanbul city and results are only used for the survey. Presumptively, the participants did not misunderstand the questions and answers them right.

2.1. Data Collection and Analysis

The survey form consisted of 3 sections. The first section is formed for collecting data on their demographic characteristics. "Entrepreneurship Scale" developed by Naktiyok is used in the second section. The scale is developed for evaluating 4 dimensions of innovation, proactive behaviors, new entrepreneurship, and renewal tendency, which included 18 questions. In addition, a comprehensive literature review is conducted, and it is seen that risk-taking, autonomy, and competition are actively used in entrepreneurship. All in all, these 3 dimensions are included in 4 dimensions, and an entrepreneurship scale of 7 dimensions and 33 questions is formed. Factor analysis made by Arat stresses on factor load to be over 0.40 in the entrepreneurship scale. Factor analysis show that there are 7 factors and 29 variables in the Entrepreneurship Scale. It is found that 7 factors revealed 71% of the total variance. Reliability analysis show Cronbach Alpha value is 0.933. In the third section, the "Social Innovation Scale" developed by Eren (2010) is performed. As a result of factor analysis, the 7th question of 9 show the factor load range is 0.559-0.777 and Cronbach Alpha coefficient is 0.858 and revealed 51.382% of the total variance.

In the current study, quantitative data collected from the managers in establishments for workers are analyzed using SPSS 23 package software. Reliability analysis of the data is conducted through the Cronbach Alpha coefficient. Skew and kurtosis values are analyzed to determine whether data in sub-dimensions are in the normal distribution. Data transformation is conducted by drawing squares for the "Social Innovation" variance that did not distribute normally. Unpaired T-Test and One-Way Variance Analysis (ANOVA) are conducted to determine whether Entrepreneurship Scale and Social Innovation Scale show significance in relation to demographic variables. Simple Linear Regression and Multiple Regression Analyses are performed to find out the predicator effect of entrepreneurship on social innovation. All analyses are performed at 95% reliability.

3. RESULTS

Reviewing demographic characteristics of the participants, 74.87% are male, 36.92% are between 31-37 years and 61.28% are married. 66.15% had bachelor's degrees and 22.82% has working experience between 6 to 8 years presented in Table 1.

3.1. Reliability Analysis of Scale Dimensions

Reliability criteria in accordance with the Cronbach alpha coefficient are as follows (Ozdamar, 1999).

Table 1. Distribution of Demographic Characteristics of Participants

	f	%
Gender		
Female	98	25.13
Male	292	74.87
Age		
24-30	141	36.15
31-37	144	36.92
38 years and more	105	26.92
Marital Status		
Married	239	61.28
Single	151	38.72
Education		
Primary school	8	2.05
High school	18	4.62
Associate degree	17	4.36
Bachelor's degree	258	66.15
Master's degree	89	22.82
Professional seniority		
Less than 2 years	27	6.92
3-5 years	62	15.90
6-8 years	89	22.82
9-12 years	79	20.26
13-16 years	72	18.46
More than 16 years	61	15.64

0.00 <α <0.40, scale is not reliable.
0.40 <α <0.60, scale is of low reliability.
0.60 <α <0.80, scale is moderately reliable.
0.80 <α <1.00, scale is highly reliable.

Table 2 shows "Renewal period" (0.719), "Autonomy" (0.780), "Competitive entertainment" (0.632), "Proactive behavior" (0.785), "Innovation" (0.787) and "Risk-taking" (0.746) are moderately reliable while "Competitive entrepreneur" (0.825) is highly reliable. The total Reliability calculation of the entrepreneurship Scale is 0.940 (highly reliable). The total Reliability calculation of the Social Innovation Scale is 0.911 (highly reliable).

3.2. Comparison of Sub-dimensions of Entrepreneurship Scale and Social Innovation Scale and Demographic Variables

Research question: Do sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with gender?

Table 3 shows "Inter-personal" (=0.512), "Autonomy" (=0.251), "Competitive entrepreneurship" (=0.248), "Proactive behavior" (=0.386), "Innovation" (=0.898), "Risk taking" (= 0.244), and "Intrapreneurship" (=0.544) do not show significance in relation to gender. In other words,

Table 2. Reliability Analysis

Dimensions	Cronbach's Alpha	*f*
Entrepreneurship Scale	0.940	29
Novel entrepreneur	0.825	7
Renewal period	0.719	4
Autonomy	0.780	4
Competitive entrepreneur	0.632	4
Proactive behavior	0.785	4
Innovation	0.787	3
Risk taking	0.746	3
Social Innovation Scale	0.911	8

new entrepreneurship, autonomy, competition power, proactive behavior, innovation, risk taking, and intrapreneurship levels of both genders show similarity. Different from this, it is found out that "Renewal period" (=0.001) show significance in accordance with gender. Moreover, it is seen that renewal duration of women (=3.88) is higher than men (=3.62).

It is seen that "Social innovation" (=0.0 15) show significance, also. Social innovation level of women (=4.21) is higher than men's (=3.98).

Research question: Do sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with age?

Table 4 shows ANOVA results "New Entrepreneurship" (=0.000), "autonomy" (=0.000), competitive entrepreneurship" (=0.000), "innovation" (=0.000), "risk taking" (=0.001), "entrepreneurship" (=0.000), and "social innovation" (=0.000) are significant in accordance with age. Paired comparison results show new entrepreneurship level of the participants between 31-37 years is considerably lower than those between 24-30 (=3.47; =0.000) and over 38 years (=3.30; =0.038). It is found out that autonomy level of the participants between 31-37 years (=3.11) is higher than those between 24-30 (=3.53; =0.000) and over 38 years (=3.71; =0.000). Entrepreneurship level of those over 38 (= 3.86) is higher than those between 24-30 (=3.53; =0.002) and 31-37 (=3.36; =0.000). Proactive behavior level of participants 31-37 (=3.21) is lower than those 24-30 (=3.74; =0.005) and over 38 (=4). Innovation level of participants between 31-37 years (=3.42) is lower than those between 24-30 (=3.53; =0.025) and over 38 (=3.73; =0.000). Risk taking level of the participants 31-37 (=2.5) is lower than those over 38 (=3.15; =0,003). Entrepreneurship level of those 31-37 (=3.21) is lower than those 24-30 (=3.49; =0.002) and over 38 (=3.66; =0.000). In innovation dimension, social innovation level of those over 38 (=4.30) is significantly higher than those 24-30 (=4.07; =0.005) and between. 31-37 (=3.81)

Research Question: Do sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with education history?

Table 3. Unpaired T Test Results to determine whether sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with gender?

	f	$\bar{X}$	*SD*	*t*	*df*	*p*
New entrepreneurship						
Female	98	3.31	0.93	0.656	388	0.512
Male	292	3.24	0.86			
Renewal period						
Female	98	3.88	0.61	3.469	206.249	0.001
Male	292	3.62	0.76			
Autonomy						
Female	98	3.33	0.88	-1.149	388	0.251
Male	292	3.45	0.90			
Competitive entrepreneurship						
Female	98	3.63	0.75	1.156	388	0.248
Male	292	3.53	0.74			
Proactive Behavior						
Female	98	3.80	0.63	0.868	233.089	0.386
Male	292	3.73	0.88			
Innovation						
Female	98	3.48	0.98	0.129	388	0.898
Male	292	3.46	1.00			
Risk taking						
Female	98	2.83	0.95	-1.167	388	0.244
Male	292	2.94	0.80			
Entrepreneurship						
Female	98	3.47	0.71	0.607	388	0.544
Male	292	3.42	0.69			
Social Innovation						
Female	98	4.21	0.34	2.451	334.102	0.015
Male	292	3.98	0.93			

Table 5 shows that "Competitive entrepreneurship" (0.272), "Proactive behavior" (=0.121), "Innovation" (=0.407), "Entrepreneurship" (0.514) and "social innovation" (0.234) are not significant in relation to education history. On the contrary, "new entrepreneurship" (=0.010), "autonomy" (=0.000), and "risk taking" (=0.000) show significance in accordance with education history. New entrepreneurship level of participants with bachelor's degree (=3.02) is lower than those with below associate degree (=3.42; =0.049) and master's degree (=3.31; =0.023). In the autonomy dimension, the autonomy level of those with master's degrees (=3.92) is significantly higher than those with associate degrees (=3.41; =0.007) and bachelor's degrees (=3.26) risk-taking level of those with master's degrees (=3.26) is higher than those with below associate degrees (=2.50; =0.030) and bachelor's degrees (=2.87).

Research Question: Do sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with Professional seniority?

Table 6 shows that "new entrepreneurship" (=0.086), "renewal period" (=0.087), "autonomy" (=0.233), "competitive entrepreneurship" (=0.0169), and "entrepreneurship" (=0.248) dimensions are not significant in relation to professional seniority. On the contrary, "proactive behavior" (=0.000), "innovation", "risk taking" (=0.004), and "social innovation" (=0.014) are significant in relation to professional seniority. Proactive behaviors of the participants with 9-12 years of professional seniority level is lower than those with 6-8 years (=3.72; =0.032) and more than 13 years (=4. 00; =0.000). The Innovation level of those 13 years and more (=3.67) is significantly higher than those with 9-12 years (=3.23; =0.020) of professional seniority. Risk taking level of the participants with less than 5 years of professional seniority (=3.12) is higher than those with 6-8 years of professional seniority (=2.71; =0.003).

Table 4. ANOVA results to determine whether sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with age

Score	*f*	$\bar{X}$	*SD*	ANOVA Results					
				Variance Source	Sum of squares	df	Mean Square	*f*	*p*
New entrepreneurship									
24-30	141	3.47	0.74	Inter-groups	15.711	2	7.855	10.661	0.000
31-37	144	3.01	0.95	In-group	285.162	387	0.737		
38 and more	105	3.30	0.87	Total	300.873	389			
Renewal period									
24-30	141	3.60	0.71	Inter-groups	4.388	2	2.194	4.108	0.017
31-37	144	3.64	0.77	In-group	206.694	387	0.534		
38 and more	105	3.86	0.69	Total	211.083	389			
Autonomy									
24-30	141	3.53	0.73	Inter-groups	24.511	2	12.255	16.404	0.000
31-37	144	3.11	0.96	In-group	289.133	387	0.747		
38 and more	105	3.71	0.89	Total	313.644	389			
Competitive entrepreneurship									
24-30	141	3.53	0.74	Inter-groups	15.348	2	7.674	14.926	0.000
31-37	144	3.36	0.75	In-group	198.967	387	0.514		
38 and more	105	3.86	0.65	Total	214.315	389			
Proactive Behavior									
24-30	141	3.74	0.89	Inter-groups	35.878	2	17.939	30.662	0.000
31-37	144	3.42	0.77	In-group	226.415	387	0.585		
38 and more	105	4.19	0.54	Total	262.293	389			
Innovation									
24-30	141	3.53	0.89	Inter-groups	17.592	2	8.796	9.225	0.000
31-37	144	3.21	1.13	In-group	368.985	387	0.953		
38 and more	105	3.73	0.86	Total	386.577	389			
Risk taking									
24-30	141	2.91	0.66	Inter-groups	9.526	2	4.763	6.987	0.001
31-37	144	2.75	0.86	In-group	263.793	387	0.682		
38 and more	105	3.15	0.97	Total	273.319	389			
Entrepreneurship									
24-30	141	3.49	0.65	Inter-groups	13.223	2	6.611	14.561	0.000
31-37	144	3.21	0.74	In-group	175.724	387	0.454		
38 and more	105	3.66	0.62	Total	188.947	389			
Social Innovation									
24-30	141	4.07	0.62	Inter-groups	638.434	2	319.217	11.657	0.000
31-37	144	3.81	1.04	In-group	10597.621	387	27.384		
38 and more	105	4.30	0,63	Total	11236.054	389			

Research Question: Do sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with a working year in the establishment?

Table 7 shows that working time had significance in accordance with all dimensions in the study. It is seen that new entrepreneurship level of the participants with 3-5 years of working time (=2.71) is lower than those with 2 years and less (=3.53; =0.000). In terms of "renewal time" (=0.000), the renewal time level of those with 3-5 years of working time (=3.32) is lower than those with 2 years and less (=3.74; =0.002) and 6-12 years. Autonomy level of those with 3-5 years of working time (=2.82) is lower than

Table 5. ANOVA results to determine whether sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with education

Score	*f*	$\bar{X}$	*SD*	ANOVA Results					
				Variance Source	Sum of squares	df	Mean Square	*f*	*p*
New entrepreneurship									
Below associate degree	43	3.42	1.26	Inter-groups	7.017	2	3.508	4.620	0.010
Bachelor's degree	258	3.31	0.85	In-group	293.856	387	0.759		
Master's degree	89	3.02	0.68	Total	300.873	389			
Renewal period									
Below associate degree	43	3.88	0.43	Inter-groups	8.432	2	4.216	8.051	0.000
Bachelor's degree	258	3.58	0.77	In-group	202.651	387	0.524		
Master's degree	89	3.89	0.70	Total	211.083	389			
Autonomy									
Below associate degree	43	3.41	1.01	Inter-groups	28.663	2	14.332	19.462	0.000
Bachelor's degree	258	3.26	0.90	In-group	284.980	387	0.736		
Master's degree	89	3.92	0.60	Total	313.644	389			
Competitive entrepreneurship									
Below associate degree	43	3.38	0.60	Inter-groups	1.436	2	0.718	1.306	0.272
Bachelor's degree	258	3.58	0.79	In-group	212.878	387	0.550		
Master's degree	89	3.56	0.66	Total	214.315	389			
Proactive Behavior									
Below associate degree	43	3.92	0.48	Inter-groups	2.849	2	1.424	2.125	0.121
Bachelor's degree	258	3.76	0.91	In-group	259.444	387	0.670		
Master's degree	89	3.62	0.65	Total	262.293	389			
Innovation									
Below associate degree	43	3.60	1.55	Inter-groups	1.792	2	0.896	0.901	0.407
Bachelor's degree	258	3.42	0.93	In-group	384.785	387	0.994		
Master's degree	89	3.53	0.86	Total	386.577	389			
Risk taking									
Below associate degree	43	2.50	0.82	Inter-groups	18.394	2	9.197	13.962	0.000
Bachelor's degree	258	2.87	0.86	In-group	254.925	387	0.659		
Master's degree	89	3.26	0.63	Total	273.319	389			
Entrepreneurship									
Below associate degree	43	3.47	0.80	Inter-groups	0.648	2	0.324	0.666	0.514
Bachelor's degree	258	3.40	0.73	In-group	188.299	387	0.487		
Master's degree	89	3.50	0.54	Total	188.947	389			
Social Innovation									
Below associate degree	43	4.18	0.39	Inter-groups	84.089	2	42.044	1.459	0.234
Bachelor's degree	258	3.97	0.94	In-group	11151.965	387	28.816		
Master's degree	89	4.16	0.56	Total	11236.054	389			

those with 2 years and less (=3.61; =0.000), 6-12 years (=3.63; =0.000) and 13 years and more (=3.65; =0.000). It is found that the level of "competitive entrepreneurship" of those with 3-5 years of working time (=3.23) is lower than those with 2 years (=3.59; =0.010), 6-12 years (=3.63; =0.000) and 13 years and more (=3.82; =0.000). Proactive behavior level of the participants with 13 years and more of working time (=4.20) is higher than those with 2 years and less (=3.65; =0.000), 3-5 years (=3.41; =0.000) and 6-12 years (=3.80; =0.000). Innovation level of the participants with 13 years and more of working time (=4.06) in the establishment is higher than those with 2 years and less

Table 6. ANOVA results to determine whether sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with professional seniority

Score	*f*	$\bar{X}$	*SD*	ANOVA Results					
				Variance Source	Sum of squares	df	Mean Square	*f*	*p*
New entrepreneurship									
5 years and less	89	3.35	0.77	Inter-groups	5.085	3	1.695	2.212	0.086
6-8 years	89	3.06	0.98	In-group	295.788	386	0.766		
9-12 years	79	3.24	0.85	Total	300.873	389			
13 years and more	133	3.33	0.88						
Renewal period									
5 years and less	89	3.62	0.89	Inter-groups	3.550	3	1.183	2.201	0.087
6-8 years	89	3.80	0.69	In-group	207,.33	386	0.538		
9-12 years	79	3.54	0.69	Total	211.083	389			
13 years and more	133	3.74	0.67						
Autonomy									
5 years and less	89	3.49	0.84	Inter-groups	3.456	3	1.152	1.434	0.233
6-8 years	89	3.39	0.90	In-group	310.188	386	0.804		
9-12 years	79	3.56	0.92	Total	313.644	389			
13 years and more	133	3.32	0.92						
Competitive entrepreneurship									
5 years and less	89	3.57	0.84	Inter-groups	2.775	3	0.925	1.688	0.169
6-8 years	89	3.44	0.68	In-group	211.540	386	0.548		
9-12 years	79	3.49	0.88	Total	214.315	389			
13 years and more	133	3.66	0.60						
Proactive behavior									
5 years and less	89	3.69	1.02	Inter-groups	18.941	3	6.314	10.015	0.000
6-8 years	89	3.72	0.64	In-group	243.352	386	0.630		
9-12 years	79	3.39	0.86	Total	262.293	389			
13 years and more	133	4.00	0.66						
Innovation									
5 years and less	89	3.46	0.95	Inter-groups	10.966	3	3.655	3.756	0.011
6-8 years	89	3.37	1.06	In-group	375.611	386	0.973		
9-12 years	79	3.23	1.08	Total	386.577	389			
13 years and more	133	3.67	0.90						
Risk taking									
5 years and less	89	3.12	0.72	Inter-groups	9.106	3	3.035	4.434	0.004
6-8 years	89	2.71	0.86	In-group	264.213	386	0.684		
9-12 years	79	3.02	0.77	Total	273.319	389			
13 years and more	133	2.85	0.91						
Entrepreneurship									
5 years and less	89	3.47	0.80	Inter-groups	2.009	3	0.670	1.383	0.248
6-8 years	89	3.35	0.66	In-group	186.938	386	0.484		
9-12 years	79	3.36	0.69	Total	188.947	389			
13 years and more	133	3.51	0.65						
Social Innovation									
5 years and less	89	4.01	0.71	Inter-groups	303.046	3	101.015	3.566	0.014
6-8 years	89	4.12	0.56	In-group	10933.009	386	28.324		
9-12 years	79	3.71	1.35	Total	11236.054	389			
13 years and more	133	4.20	0.54						

Table 7. ANOVA results to determine whether sub-dimensions of entrepreneurship scale and social innovation scale show significance in accordance with working year

				ANOVA Results					
Score	***f***	$\bar{X}$	***SD***	**Variance Source**	**Sum of squares**	**df**	**Mean Square**	***f***	***p***
New entrepreneurship									
2 years and less	98	3.53	0.84	Inter-groups	41.373	3	13.791	20.514	0.000
3-5 years	99	2.71	0.83	In-group	259.500	386	0.672		
6-12 years	114	3.33	0.80	Total	300.873	389			
13 years and more	79	3.50	0.81						
Renewal period									
2 years and less	98	3.74	0.94	Inter-groups	20.255	3	6.752	13.657	0.000
3-5 years	99	3.32	0.69	In-group	190.827	386	0.494		
6-12 years	114	3.76	0.57	Total	211.083	389			
13 years and more	79	3.96	0.53						
Autonomy									
2 years and less	98	3.61	0.90	Inter-groups	48.833	3	16.278	23.727	0.000
3-5 years	99	2.82	0.77	In-group	264.810	386	0.686		
6-12 years	114	3.63	0.85	Total	313.644	389			
13 years and more	79	3.65	0.76						
Competitive entrepreneurship									
2 years and less	98	3.59	0.81	Inter-groups	16.894	3	5.631	11.011	0.000
3-5 years	99	3.23	0.77	In-group	197.420	386	0.511		
6-12 years	114	3.63	0.60	Total	214315	389			
13 years and more	79	3.82	0.66						
Proactive behavior									
2 years and less	98	3.65	1.04	Inter-groups	28.651	3	9.550	15.778	0.000
3-5 years	99	3.41	0.80	In-group	233.642	386	0.605		
6-12 years	114	3.80	0.60	Total	262.293	389			
13 years and more	79	4.20	0.58						
Innovation									
2 years and less	98	3.57	1.00	Inter-groups	56.491	3	18.830	22.020	0.000
3-5 years	99	2.94	0.95	In-group	330.086	386	0.855		
6-12 years	114	3.42	0.99	Total	386.577	389			
13 years and more	79	4.06	0.67						
Risk taking									
2 years and less	98	3.08	0.70	Inter-groups	10.433	3	3.478	5.106	0.002
3-5 years	99	2.67	0.89	In-group	262.886	386	0.681		
6-12 years	114	2.89	0.84	Total	273.319	389			
13 years and more	79	3.05	0.85						
Entrepreneurship									
2 years and less	98	3.55	0.81	Inter-groups	27.961	3	9.320	22.347	0.000
3-5 years	99	3.00	0.66	In-group	160.986	386	0.417		
6-12 years	114	3.50	0.53	Total	188.947	389			
13 years and more	79	3.74	0.55						
Social Innovation									
2 years and less	98	4.12	0.74	Inter-groups	1089.317	3	363.106	13.813	0.000
3-5 years	99	3.73	0.77	In-group	10146.738	386	26.287		
6-12 years	114	3.99	1.06	Total	11236.054	389			
13 years and more	79	4.39	0.30						

(=3.57; =0.001), 3-5 years (=2.94; =0.000) and 6-12 years (=3.42; =0.000). Risk taking level of the participants with 3-5 years of working time (=2.67) is lower than those with 2 years and less (=3.08; =0.002) and 13 years and more of working time (=3.05; =0.021). Entrepreneurship level of those with 3-5 years of working time (=3.00) is lower than those with 2 years and less (=3.55; =0.000) 6-12 years (=3.50; =0.000) and 13 years and more (=3.74; =0.000). Social innovation level of the participants with 13 years and more of working time in the establishment (=3.73) is higher than the participants with 2 years and less (=4.12; =0.016) 3-5 years (=3.99; =0.000) and 6-12 years (=4.39; =0.005).

4. CONCLUSION

The purpose of the study is to determine the effects of the entrepreneurship tendency of organizational employees on social innovation. The study employed scales the reliability and validity of which are conducted in previous research. Factor analysis is performed to determine their structure validity. As a result, it is seen the factors are effectively explained. The study is conducted with 390 participants working in Demirdöküm Factories. The Innovation Scale includes 29 and the Social Innovation Scale consists of 8 questions.

The total reliability analysis calculation of entrepreneurship scale is 0,940 (highly reliable) and of social innovation scale is 0,911 (highly reliable). The results of the study are as follows:

- It is seen that the dimensions of renewal and social innovation show significance level in accordance with gender. Renewal and social innovation levels of women are higher than men.
- The levels of new entrepreneurship and renewal of the participants between 31-37 years are lower than those between 24-30 and 38.
- Competition levels of those over 38 years are lower than those between 24-30 and 31-37.
- The levels of proactive behavior and innovation of the participants 31-37 are lower than those 24-30 and 38 and more.
- Risk taking level of the participants between 31-37 years is lower than those 38 years and more.
- Entrepreneurship level of the participants between 31-37 years is lower than those between 24-30 years and 38 years and more.
- Innovation level of the participants who are 38 and more years is higher than those between 24-30 and 31-37.
- New entrepreneurship level of the participants with master's degree is lower than those with bachelor's degree and below.
- Innovation level of the participants with associate degree and below is significantly lower than those with bachelor's degree.
- Autonomy and risk-taking levels of those with master's degree are significantly higher than those with associate degree and bachelor's degree.
- Proactive behavior level of the participants with 9-12 years of professional seniority is significantly lower than those with 6-8 years and 13 years and more of professional seniority.
- Innovation level of the participants with 13 years of professional seniority is higher than those with between 9-12 years.
- Risk taking level of the participants with 5 years and less is higher than those with 6-8 years of professional seniority.
- New entrepreneurship level of the participants with 3-5 years of working time in the establishment is significantly lower than those with 2 years, 6-12 years and 13 years and more.
- Innovation level of those with 13 years and more of professional seniority is higher than those with 2 years and less, 3-5 years and 6-12 years of professional seniority.
- Autonomy and competitive entrepreneurship levels of those with 3-5 years of working history in the establishment is lower than those with 2 years and less, 6-12 years and 13 years and more.
- Proactive behavior level of the participants with 13 years and more of working time in the establishment is significantly higher than those with 2 years and less.
- Innovation level of the participants with 13 years and more of working time in the establishment is significantly higher than those with 2 years and less, 3-5 years and 6-12 years.
- Risk taking level of the participants with 3-5 years of working time in the establishment is significantly lower than those with 2 years and less, 3-5 years and 6-12 years and 13 years and more.
- Social innovation taking level of the participants with 13 years of working time in the establishment is significantly higher than those with 2 years and less, 3-5 years and 6-12 years
- It is found that there is a positive and significant association between social innovation level and entrepreneurship. In other words, as creativity level of employees and workers increase, their entrepreneurship level rises.

In general, the study is conducted to determine the effects of entrepreneurship tendencies on social innovation. The dimensions of entrepreneurship affect social innovation dimensions that can develop via social entrepreneurs. In a community, if the individuals are of social innovation qualities, that community will develop in a fast way.

The literature review shows that there are only a handful of studies conducted on entrepreneurship and social innovation. Thus, it is thought the current study is of a high significance for future research.

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Innovative Work Behaviour as Determinant of Process Innovation: An Empirical Analysis

Süreç Yeniliğinin Belirleyicisi Olarak Yenilikçi İş Davranışı: Ampirik Bir Analiz

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ABSTRACT

The purpose of this paper is to study empirically the relationships between innovative work behaviour and process innovation. The paper hypothesis was created in the light of the literature. That hypothesis is validated using the Partial Least Squares, by Smart PLS statistical program, data collected by the survey method from the 62 firms located in technoparks in Istanbul. The findings revealed that innovative work behaviour is considered to be one of the key factors in both increasing and inhibiting process innovation. The findings supported our hypothesis. There is significant and positive relationships between innovative work behaviour and process innovation. This research presents findings that firms should support innovative work behaviour in order to increase process innovation. This paper jointly examines as an empirically in the same model the little-researched links between innovative work behaviour and process innovation.

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Yenilikçi iş davranışı, süreç yeniliği, teknopark, Türkiye.

ÖZ

Bu makalenin amacı, yenilikçi iş davranışı ve süreç yeniliği arasındaki ilişkileri ampirik olarak incelemektir. Bu makalenin hipotezi literatür incelemesi ışığında oluşturulmuştur. Bu hipotez, Smart PLS istatistik programıyla, İstanbul'daki teknoparklarda yer alan 62 firmadan anket yöntemiyle toplanan verilerin, Kısmi En Küçük Kareler metodu kullanılarak analiz edilmesiyle doğrulanmıştır. Bulgular, yenilikçi iş davranışının süreç yeniliğini hem artıran hem de engelleyen kilit faktörlerden biri olarak saptanmıştır. Bulgular, hipotezimizi desteklemiştir. Yenilikçi iş davranışı ile süreç yeniliği arasında anlamlı ve olumlu ilişkiler saptanmıştır. Bu araştırma, firmaların süreç yeniliğini artırmak için yenilikçi iş davranışını desteklemesi gerektiğine dair bulgular sunmaktadır. Bu makale, yenilikçi iş davranışı ve süreç yeniliği arasında, daha önce gözden kaçırılarak az araştırılmış bağlantıları aynı model içinde ampirik olarak birlikte incelemektedir.

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1. INTRODUCTION

Innovative work behaviour is an important organizational capability that provides competitive advantage in management studies. Competitive advantage is the critical key to intense global competition and lasting economic progress (Korzilius et al., 2017). Innovation is a strategy that is part of a firm's strategic plan. A firm produces product innovation, service innovation and process innovation with the innovation capability it has accumulated throughout its history (Eriksson, 2014). Earlier various studies theorically or empirically test the effects, antecedents and outcomes of innovative work behaviour or innovation as separately with other else concepts. Yet there isn't been found that deals with an interactive process which connects these two variables in the same model especially as an empirically.

There has been a great deal of theoretical and empirical interest in product and service innovation. But our knowledge and understanding of process innovation is still underdeveloped. As a result, there is little guidance on how firms can foster process innovation available to managers and policy makers (Dost et al., 2020, p. 1). The focus of earlier researchers, innovation has been traditionally focused on products in the manufacturing sectors at first; processes were apparently thought to be non-innovative, because they were assumed to be unproductive activities (Ramamoorthy et al., 2005). Nowadays, however, process innovation is considered to be a valuable component of the economic order. Firms therefore need skilled and innovative experts (Dost et al., 2020, p. 1). The lack of empirical research between innovative work behavior and process innovation has attracted our attention. Therefore, to address this research gap, we examine the influence of innovative work behaviour on process innovation as an determinant of process innovation.

Innovative work behaviour is defined as the process by in which employees, through their efforts and behaviours, transform their ideas into practices (Kleysen & Street, 2001). Rather than evaluating innovation as not only outcomes, but also it is necessary to think of it as a whole interrelated process (Nieves et al., 2014).

Innovative work behaviour, e.g. the development, adoption and implementation of new product innovation ideas, is a driving force for companies that want to compete globally and is an important capability that enables a company to succeed in a dynamic environment (Yuan & Woodman, 2010, p. 323). Innovative work behaviour differs from other workforce in terms of showing various qualities. These qualities of people in a firm or group that are flexible, help identify problems and encourage creativity in solving problems reflect the degree to which they differ from other staff members (Korzilius et al., 2017). We put forward these micro innovative work qualities contribute to process innovation in the firms.

This paper will contribute to the relevant literature from the perspective microfoundation of dynamic capabilities, as it is carried out on the managers of service and manufacturing firms with an innovation agenda in technoparks. We have drawn on microfoundation of dynamic capabilities literature in our theorizing. Winter (2003, p. 983) defines a capability as "*a high level routine that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type*". Dynamic capabilities are set to affect overall organizational change and development (Felin et al., 2012; Frishammar et al., 2012).

In the microfoundation of dynamic capabilities context, through the ability to innovatively change the way the firm solves its problems, managers can, in the presence of rapidly changing problems, navigate through them by creating process innovation. For this, we believe that the firm's behaviour of discovering the firm's problems, generating and implementing innovative solutions can lead to an increase in the firm's management capability, thus, that managers' micro-based innovative work behaviour can be a key internal antecedent of process innovation. In the studies conducted so far, the relationships between innovative work behavior and process innovation have been neglected in the empirically and theoretically context we have drawn. Therefore, this paper can theoretically and empirically expand on previous research.

2. LITERATURE

2.1. Innovative Work Behaviour (IWB)

Janssen (2000, p. 288) defines innovative work behaviour as "*the deliberate creation, promotion and implementation of innovative ideas to benefit the role, performance, group or organization*". It involves rethinking and changing the principles underlying work considerations in an innovative way. According to Messmann and Mulder (2012, p. 45), IWB "*reflects the sum of physical and cognitive work activities performed by employees, either alone or in a social setting, in their work context to perform a set of tasks*". According to De Jong and Der Hartog (2010), IWB is a four-dimensional process that includes "*discovering a problem related to a task or organization, defining it, producing a solution, advocating for the solution, and translating it into practice*". While defining the problem by discovering and producing a solution is related to creativity; advocating and transforming creative ideas into practice is about innovative work behaviour. Most researchers see IWB as a multi-step process and creativity is reflected in its first phase. The employee first identifies problems at work and then generates new ideas; then gets support for the new idea(s) from others (e.g. managers or colleagues; in the next stages), implements the working idea(s) and makes it a reality by producing a new prototype or business model. Each stage of the process consists of different behaviours that deliberately introduce new ways of do-

ing things that create innovation in a new product, process, market or organisational structure (Janssen, 2000; Scott & Bruce, 1994; Wu, de Jong, Raasch & Poldervaart, 2020).

Creativity is generating new and useful ideas at the individual level; innovation is the process that includes taking these ideas as commercializable, developing them and transforming them into marketable (McLean, 2005, p. 240). Therefore, innovative work behaviour is a broader concept that includes the discovery, generation, advocacy and application of creative ideas and includes creativity, which is necessary for innovation. As a matter of fact, innovation is basically a process consisting of innovation initiation and commercialization, and some theoretical studies (Bos-Nehles et al., 2017) argue that IWB are the essence of innovation.

2.2. Process Innovation (PRCI)

In order for a process to be considered new, it must be new in terms of end users, firms, producers, distribution channels and production technology (Brockman and Morgan, 2003, p. 388). According to previous literature, PRCI is recognised as a critical factor to reduce costs, increase production volume, reduce product development time, improve product quality and reliability, improve performance, increase market share and dominance, gain efficiency and competitiveness and achieve economic success (Dost et al., 2020, p. 1; Frishammar et al., 2012, p. 1; Robertson, Casali & Jacobson, 2012, p. 824). For this reason, all firms use some PRCI that directly or indirectly contribute to their competitiveness. Despite the importance of PRCI for firms, it has received relatively little academic attention. Instead, most previous studies have focused on product innovation and PRCI has been largely ignored. In fact, there are important interdependencies, tightly links between process and product innovation. For example, when product innovation involves unusual techniques that have not been used before, it is often necessary to change processes. If the new product or service is successful, further process improvements will be needed as production scales up (Frishammar et al., 2012, p. 526; Robertson, Casali & Jacobson, 2012, p. 824; Chirumalla, 2021, p. 1). But there are a many challenges in front of a PRCI. Sjödin et al. (2018) categorized that challenges for PRCI as (Chirumalla, 2021):

- lack of a shared vision and challenges for people in relation to capability development
- an uncertain business situation and related technology challenges,
- the difficulty of changing conventional routines and related business processes
- lack of systematic approach in adopting modern project models and related process challenges
- the existence of a rigid culture and difficulty of changing it.

3. HYPOTHESIS DEVELOPMENT

In order to understand a firm's processes and key raw materials for manufacturing products and services, PRCI is a key requirement. PRCI often involves both technological, managerial and practical changes in the firm's processes, such as blockchain, ICT use, transformation to digitalisation, adoption of new management practices and introduction of new equipment (Chirumalla, 2021). Another example is that the Japanese superiority in various sectors -automobiles, motorbikes, consumer electronics, etc.- is mainly due to their superior production abilites, which are the result of continuous process innovation (Davenport, 1993, p. 2). In particular, the Japanese firms' decomposition of processes into their basic components (e.g. 5S, 6 Sigma, Total Quality Management), measurement of their performance and continuous improvement of these components has been an important factor in their achievement of a worldwide competitive advantage (Cumming, 1998, p. 21). Gaining a competitive advantage may not progress simultaneously with maintaining it at the same time. As a solution to this, a well-developed dynamic capability can adapt and transform other abilities. Firms need dynamic capability that allows them to innovate and restructure their PRCI activities across times (Frishammar et al., 2012, pp. 7–8). PRCI requires changes in the way the firm does things (Chirumalla, 2021, p. 1). Innovative work behaviour as a dynamic capability can generate, adapt and transform process innovations into other process innovations. In this way, firms achieve maintaining in its competitive advantage. IWB involves turning problems into innovative opportunities, "*understanding the problem", "generating new solutions", "finding support for solutions*" and ultimately "*implementing*" them. In terms of dynamic capabilities, innovative work behaviour may be associated with a wide variety of interrelated activities of problem discovery, solution generation, knowledge acquisition, modification, integration, dissemination, application as well as established creativity to develop and implement PRCI (e.g., Teece, 2007; Zollo & Winter 2002). As a matter of fact, the development and implementation of innovations takes place through the efforts of motivated individuals who use their knowledge and skills to produce innovative products and processes (Taghipour & Dezfuli, 2013). The value of process innovation through the lens of dynamic capabilities has only recently begun to emerge, although there is a growing body of academic work on dynamic capabilities in new product development (e.g. Chirumalla, 2021). According to Teece (2007), dynamic capabilities ensure sustained firm performance and facilitate the creation, deployment and protection of intangible assets. The micro-foundations of dynamic capabilities that underpin the "*sensing, capturing and reconfiguring of capabilities*" at the firm level are difficult to develop and implement (Teece, 2007). In this paper, by asking whether managers' innovative work behaviours sup-

port to process innovation as one of the microfoundations of dynamic capabilities, we aim to establish a link between dynamic capabilities and process innovation in the technology and innovation management (TIM) literature. Thus, we want to be able to deduce that if there is process innovation in a firm, there will be managers in critical positions who exhibit innovative work behaviours in that firm. We would like to small contribute to the development of this theoretical framework and to the verification of the theoretical constructs adopted in the literature, which are still open to question, with our quantitative research discussed in this article. So, the following hypothesis was formed.

Hypothesis: *Innovative work behavior positively relates to process innovation.*

4. RESEARCH DESIGN, METHODOLOGY AND FINDINGS

4.1. Data Collection and Sample

In that context, we worked on firms that have made research and development, technology and innovation a part of their firm mission. It has been researched with objective methods and tools by taking the Technology Development Zones (TDZ) in the Marmara Region of Turkey and Istanbul into the lens, during the peak period of COVID-19. The sampling of the research consisted of firms located in technopark firms. Data was collected through a survey method. 75 top, middle or sub-level managers provided feedback. This paper is a firm-level research, thus, we were used responses from 62 firms in its.

4.2. Measures and Scales

As a data collection tool, a questionnaire with 14 questions consisting of two different scales were used. These scales are as follows; the "*innovative work behaviour scale*", a 10 item instrument developed by De Jong and Den Hartog (2010), was used to measure IWB in knowledge-intensive firms. The scale used was loaded on a single factor in a factor analysis. It was developed by De Jong and Den Hartog as 17 items and then 10 items were considered as a single dimension in their 2010 study. The second scale used in this paper is the "*process innovation scale*" which consist of the one-dimensional and 4-questions. It was used by Akgün et al. (2009). They were derived from the scale by Wang et al. (2004). We asked the participants to answer the questions "*considering the past three years*".

These both scales have 5-points likerts type ("1: never" to "5: always"). The data in the research were collected from the managers of the firms with a process innovation agenda by the survey method.

4.3. Analysis of Data

Data were analyzed with Smart PLS programs. "*Descriptive analyzes, validity and reliability analyzes, hypothesis testing*" were performed on the data of this study. Among the tests performed, the reliability and validity of the scales, the goodness of model-data fit and the results of the hypothesis test are explained in detail below in Tables and Figure.

4.4. Descriptive Statistics

The 62 firms, participating in this research, are mainly small and medium-sized. And they stated that the age of the firm in terms of total industry experience is between mainly 11-20 years and 21-30 years. The descriptive statistics of the participants firms are presented in Table 1 and Table 2.

The scales' descriptive information and correlation table are shown. Accordingly Table 2, there is a significant relationship between innovative work behaviour and process innovation at the 0.01 significance level. There is no significant relationship between the size or age of the organization and other variables.

Table 2. Correlations (Pearson) and Descriptive Statistics for Scales

	1	2	3	4	Mean	Std. D.
1 Size	1				2,55	1,32
2 Age	,300	1			3,27	1,22
3 IWB	-,171	-,079	1		4,13	,50
4 PRCI	-,238	,066	,589**	1	3,79	,78

**. Correlation is significant at the 0.01 level (2-tailed). N: 62.

Table 1. Descriptive Statistics for Participants

Size of Firm (Number of employees)			Age of Firm (Number of years since the firm was total industry experience)		
	n	%		n	%
Micro (1 to 9)	9	14,5	5 years and less	4	6,5
Small (10 to 49)	4	6,5	6-10 years	2	3,2
Medium (50 to 249)	10	16,1	11-20 years	9	14,5
Large (250 to 499)	3	4,8	21-30 years	10	16,1
Larger (500 employees and above)	3	4,8	31 years and above	4	6,5
Sum	29	46,8	Sum	29	46,8
Non-responded only this question	33	53,2	Non-responded only this question	33	33
Sum	62	100,0	Sum	62	100,0

Table 3. The number of questions of the scales, construct validity and reliability analysis

	Cronbach's Alpha	rho_A	Composite Relabiltiy (CR)	Average Variance Extracted (AVE)	N of Items
Innovative Work Behaviour	0,911	0,932	0,907	0,534	9
Process Innovation	0,838	0,883	0,842	0,582	4

4.5. Reliability and Validity Analyzes

The reliability of the reflective variable for the analysis of the research were found to be high.

Table 3 presents results of reliability of constructs by using Cronbach Alpha and rho-A scores.

All constructs fulfilled the threshold of 0.70 (Hair et al., 2017; Nunnally, 1978). Construct validity (discriminant and convergent) was assessed based on confirmatory factor analysis using the criteria recommended by Hair et al. (2010; 2017), i.e. item factor loadings must be greater than 0.50, composite reliability must be greater than 0.70, average variance extracted (AVE) must be greater than 0.50, and AVE must be greater than the squared correlation of that construct with other constructs (Chin, 1998). When the factor loadings were analyzed, among the factors measuring innovative work behaviour, the loading of a factor, corresponding to the first question, was dropped, because it was far below the acceptable thresholds (< .30). Since the AVE and CR coefficients of all other factors were above the threshold values, they were kept in the measurement model. The information on factor loadings is given in the Figure 1. Table 3 presents Cronbach's Alpha, rho_A, CR and AVE scores are within the acceptable range.

According to Table 4, Fornell and Larcker (1981) given discriminant validity is accepted since a diagonal value bold is higher than the value in its row and column. Repeatedly, the bold value is represented for square root of AVE while the other value is the correlation of latent constructs.

According to Henseler et al. (2015), HTMT coefficient should be smaller than 0.85. When the HTMT coefficient is checked, it is seen that the research model satisfies the criterion of discriminant validity. This measure is given in Table 5.

According to Table 3, Table 4 and Table 5 structure achieves the need for convergent, divergent and structural, validity and reliability.

4.6. Research Model and Data Goodness of Fit Values

According to Cohen (1988), the R^2 effect size is classified as small ($.02 \leq R^2 < .13$), medium ($.13 \leq R^2 < .26$) and large ($.26 \leq R^2$). Our research model found the calculated effect size to be .28, so innovative work behaviour broadly explains 28% of the variation on process innovation.

According to Stone-Geisser (1974), the evaluation of the Q^2 statistic, in other words predictive fitness, is used to check whether the endogenous variables are estimated correctly. According to Chin (1998), if the Q^2 value is greater than 0, the research model has a good predictive explanatory level. According to this approach, for the model to have predictive power, $Q^2>0$ should be (Becker et al., 2012; Hu & Bentler, 1999). It shows at what level the independent variable (innovative work behaviour) predicts the dependent variable (process innovation) according to predictive power analysis (Q^2). $Q^2> 0$ for the model to have predictive power. The fact that the Q^2 value of our research model was found to be .12, proves that it has a good explanatory level.

According to Cohen (1988), the f^2 effect size is classified as low ($.002 \leq f^2 < .15$), medium ($.15 \leq f^2 < .35$) and high ($.35 \leq f^2$). Our research model found the calculated effect size to be .37, innovative work behaviour was found to have a high effect size on process innovation.

SRMR (Standardized Root Mean Square Residual) value is used to determine the model-data fit in PLS-SEM. As the SRMR value approaches "0", the goodness of fit of the model increases. If the model has an SRMR value of less than 0.05, it is in good fit; if it has an SRMR between 0.05 and 0.10, it is in acceptable fit. According to Hu and Bentler (1999), the SRMR < .08 condition is an indicator of goodness of fit. In our research, it has been proven that the model-data goodness-of-fit condition is met with SRMR< .08.

According to Hair et al., (2017) the variance inflation factors (VIF) level must be < 5. When we examined the multicollinearity levels between the variables and we found the result was 1.01. This result was shown, there was no linearity problem between the variables.

Table 6 presents VIF, R^2, Q, f^2 and SRMR scores are within acceptable range.

Table 4. Discriminant Validity Results (Fornell & Larcker Criterion)

	Innovative Work Behaviour	Process Innovation
Innovative Work Behaviour	,731	
Process Innovation	,525	0,763

Table 5. Discriminant Validity Results (Heterotrait Monotrait Ratio-HTMT Coefficient)

	Innovative Work Behaviour
Process Innovation	,514

Table 6. Model-Data Goodness of Fit Values

	Path	VIF	R^2 Adj.	Q^2	f^2	SRMR
Hypothesis	IWB → PRCI	1.01	0.28	0.12	0.37	0.08

4.7. Hypothesis Testing

The paper uses a SEM methodology to test the hypothesis. As a result of the good validity and reliability results of the research shown in the tables above, the following model created in the Smart PLS program has emerged.

According to Figure 1 and Table 7, the research findings show that innovative work behaviour predicts process innovation statistically positively (β = .37, p<.01), therefore hypothesis is supported. Table 7 presents the results.

5. LIMITATIONS AND FUTURE RESEARCH

There are some limitations of this paper that may provide an opportunities for future research.

The first limitation of this study is that this study was conducted at the management level of the firms. The effect between two groups of employees' IWB and managers' IWB on PRCI can be investigated.

The second limitation is that this research is a quantitative. Mixed type of research -qualitative and quantitative- can be conducted in which qualitative questions are also used.

The third limitation is that the focus of this paper is one internal determinant based on microfoundation of dynamic capabilities. Conducting the research with structural, external or environmental determinants would help to broaden the scope and conclusions of the study. In addition, other internal resources within the firm that may have an impact on process innovation -such as, organisational culture, etc.- could be added to the study. The impact of the role and interaction of complementary resources and capabilities on process innovation may be considerable. Firms' process innovation may depend on the interaction of internal and external factors. It would be valuable to examine the interaction between intrinsic and extrinsic antecedents and to identify inhibiting factors. Variables from the field of organisational behaviour and human resource management can also be selected, especially about what the inhibiting factors are. Future research may continue to focus on examining the antecedents as a whole.

The fourth limitation is that this paper only examined IWB on PRCI. Product innovation is the most studied type of innovation, but other types require research. Future research could contribute to extend the results by investigating other types of innovation, -e.g. incremental-radical innovation, open-close innovation, etc.-. It would also be useful to examine the change of effect of antecedents into outcomes for sustainable innovation and competition.

In addition, it could be investigated whether there are effects that weaken or strengthen the relationship between IWB and PRCI. In other words, it would be useful to know the contribution of innovative work behaviour, its role among other sources known to have an impact on process innovation, whether it is enabling or inhibiting and under what conditions. As a matter of fact, under which conditions the positive effect of individual level contributions to process innovation at firm level is repetitive. In order to investigate this, it may be suggested to approach this issue with different perspectives.

Another future research suggestion is that if IWB is divided into two or more dimensions on a larger sample, it can show which dimension is more effective on process innovation. Because, according to De Jong et al. (2010), the measurement of IWB is still at an evolutionary stage.

Table 7. Hypothesis Test Result

	Path Model	β	St. D.	t	p	%95 (CI)	Result
Hypothesis	IWB → PRCI	0.37	0.09	3.00	0.003**	0.31; 0.74	Supported

p<0.05*, p<0.01**, p< 0.001***, 2-tailed.

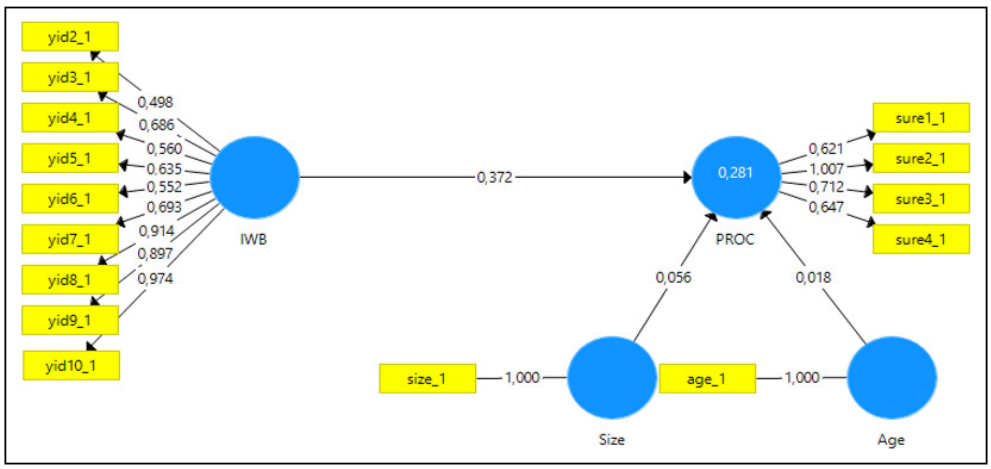

Figure 1. Construct Structural Model Path and Factor Analyses.

6. CONCLUSION

Schumpeter was the first economist to consider product innovation as a driver of economic progress and product innovation has retained the same strategic importance ever since (Garcia & Calantone, 2002; Schumpeter, 1941), thus, despite the increasing number of studies on product innovation through the lens of dynamic capabilities, PRCI research has only just begun to be addressed through the lens of dynamic capabilities (Chirumalla, 2021).

In fact, product and PRCI or development are two complementary elements. Because price sensitivity becomes a strategic variable when products are similar in the market. According to Porter (1980), firms that produce goods and services at a lower cost on the basis of more efficient processes will increase their market share and market dominance (Robertson et al., 2012, p. 824). Therefore, firms have a strong incentive to consider any IWB and PRCI, whether internal or external, that offers productivity gains and lower costs. Considering that firms are faced with technological opportunities, changing markets, new customer demands and new competitive environments today, it is thought that the need to focus on IWB, which is one of the basic microfoundation, deserves a conscious awareness that requires determination. Because, at the same time, gaining a competitive advantage may not progress simultaneously with maintaining it over time (Frishammar et al., 2012, pp. 7–8). So, we highlighted, as a determinant solution, a well-developed innovative work behaviour can generate, adapt and transform other innovative capability as well, such as process innovation We argue that firms require IWB as a microfoundation of dynamic capabilities that enables them to renew and reconfigure their PRCI activities over time.

Originating from a capability-based perspective, this article focuses on the importance of IWB in order to create process innovations suitable for all these driving and attractive forces within the framework of dynamic capabilities. Because, there is a lack of empirical evidence in the relevant literature to support this relationship that this article explores. The studies so far, the relationship between innovative work behaviour and process innovation have been ignored in the empirical or any context we have drawn. Therefore, this paper can empirically extend and support the results of previous research in the context of microfoundation of dynamic capabilities.

Our findings support our hypothesis. This paper presents empirical evidence from Turkey. According to this study, innovative work behaviour has an important link on process innovation, Accordingly this paper result, PRCI requires IWB. Managers should develop IWB of both themselves and their employees. PRCI is closely related to IWB. This article from the perspective microfoundation of dynamic capabilities, "*exploration of opportunities, generation solutions, championing and implementation*", which are components of innovative work behaviour are found to be interrelated activities that enhancing process innovation and empirically support the relevant literature (e.g., Teece, 2007; Zollo & Winter, 2002). IWB as a microfoundation of dynamic capability can generate, apply or adapt and transform PRCI into other process innovations.

Innovative work behaviour represents changes or modifies in the way the firm does work and process innovations require understanding firm's product processes and its raw materials use to the product and change it. Based on the empirical results of this article, which contributes to the ongoing studies in the related field, can be easily said that it is difficult, for companies that ignore innovative work behaviour, to implementing process innovation. IWB as a microfoundation of a dynamic capabilities is a key role to the evolution of PRCI.

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Analysis of Factors Affecting Corporate Governance Maturity Level: A Research on the Companies Traded on Borsa İstanbul

Kurumsal Yönetim Olgunluk Düzeyini Etkileyen Faktörlerin Analizi: Borsa İstanbul'da İşlem Gören Şirketler Üzerine Bir Araştırma

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ABSTRACT

Corporate governance, one of the management theories, is one of the important topics for companies. Compliance with corporate governance principles is a sensitive issue, especially in companies whose shares are traded on stock exchange markets, which have thousands/millions of investors and stakeholders, and/or operate internationally. Today, the economic activities of companies and their social interaction with their ecosystem have become dynamic on a national and global scale. The basic principles of corporate governance "transparency", "responsibility", "accountability", "fairness" and the related obligations have great importance for companies. In Turkey, listed companies are obliged to comply with a significant part of the corporate governance principles with the regulations of the Capital Markets Board. As for the items that they are not obliged to comply with, as of 2018, there are reporting obligations with the "comply or explain" view on the Public Disclosure Platform operated by the Central Registry Agency. In this study, trading duration after initial public offering and corporate governance compliance reports of publicly traded companies have been taken into account, and Corporate Governance Maturity Level and Corporate Governance Maturity Index were studied with the developed methodology based on the subsections of "Shareholders", "Transparency", "Stakeholders" and "Board of Directors". In the study, the effect of the duration after initial public offering on the Corporate Governance Maturity Level was examined in general and by subsections using Tukey HSD analysis. It is envisaged that being first study on this subject, it will have a leading impact on further next academic studies. As a result of the study, i) Except for 2021, when the number of newly traded companies is high, the Corporate Governance Maturity Index values of the listed companies tend to increase. ii) The maturity level of industrial companies is above the stock market average. iii) While the maturity level of listed companies is higher in terms of principles regarding public disclosure, it is the lowest in terms of principles related to the board of directors. iv) There is an improvement in the Corporate

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Governance Maturity Level, depending on the length of time the companies are traded on the stock exchange, and the level of compliance with the principles regarding public disclosure and transparency and shareholders is relatively higher.

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ÖZ

Yönetim teorilerinden kurumsal yönetim, işletmeler için önemli başlıklardandır. Özellikle payları borsada işlem gören, binlerce/milyonlarca yatırımcısı ve paydaşı bulunan ve/veya uluslararası faaliyet gösteren şirketlerde, kurumsal yönetim ilkelerine uyum hassas konulardandır. Günümüzde işletmelerin ekonomik faaliyetleri ve bulundukları ekosistemle sosyal etkileşimi, ulusal ve küresel ölçekte dinamik hale gelmiştir. Kurumsal yönetimin temel ilkeleri "şeffaflık", "sorumluluk", "hesap verebilirlik", "adillik" ve bunlara dair yükümlülükler şirketler için büyük önem taşımaktadır. Türkiye'de Sermaye Piyasası Kurulu düzenlemeleriyle, payları Borsa İstanbul'da işlem gören şirketler kurumsal yönetim ilkelerinden önemli kısmına uymakla yükümlüdür. Uymaya zorunlu olmadıkları maddelere ilişkin ise 2018 yılı itibariyle, Merkezi Kayıt Kuruluşu tarafından işletilen Kamuyu Aydınlatma Platformu'nda "uy ya da açıkla" bakışı ile raporlama yükümlülükleri bulunmaktadır. Bu çalışmada, halka açık şirketlerin halka arz yılları ve kurumsal yönetim uyum raporları esas alınarak, kurumsal yönetime ilişkin "Pay Sahipleri", "Kamuyu Aydınlatma", "Menfaat Sahipleri", "Yönetim Kurulu" bölümleri bazında Kurumsal Yönetim Olgunluk Düzeyi gelişimleri ve Kurumsal Yönetim Olgunluk Endeksi, çalışmada geliştirilen metodoloji ile incelenmiştir. Çalışmada, ayrıca şirketlerin borsada işlem görme süresinin Kurumsal Yönetim Olgunluk Düzeyine etkisi Tukey HSD analizi kullanılarak genel olarak ve bölümler itibariyle araştırılmıştır. Bu konuda da yapılan ilk çalışma olarak sonraki akademik çalışmalara yön vereceği düşünülmektedir. Çalışma sonucunda, i) Yeni işlem görmeye başlayan şirket sayısının yüksek olduğu 2021 yılı dışında, Borsa şirketlerinin Kurumsal Yönetim Olgunluk Endeksi değerlerinin artış eğiliminde olduğu, ii) Sınai şirketlerin olgunluk düzeyinin borsa ortalamasının üstünde gerçekleştiği, iii) Kamuyu aydınlatmaya ilişkin ilkeler açısından borsa şirketlerinin olgunluk düzeyi daha yüksek iken, yönetim kuruluna ilişkin ilkeler açısından en düşük olduğu, iv) Şirketlerin borsada işlem görme süresine bağlı olarak, Kurumsal Yönetim Olgunluk Düzeyinde gelişim olduğu, özellikle kamuyu aydınlatma ve şeffaflık ile pay sahiplerine ilişkin ilkelere uyum düzeyinin daha yüksek olduğu tespit edilmiştir.

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1. INTRODUCTION

Corporate governance is a management approach that takes into account the relations between the company's management, the board of directors (BoD), shareholders, and other stakeholders, and provides a structure in which the company's goals, the means to achieve these goals, and how performance will be monitored. In the Organization for Economic Co-operation and Development's (OECD) Corporate Governance Principles, corporate governance aims to help create an environment of **trust, transparency,** and **accountability** necessary to foster long-term investment, financial stability, and business integrity and thereby supporting stronger growth and more inclusive societies. (OECD, 2016)

After the 1990s, with the corporate scandals, systemic crises, changes in the shareholding structures of companies, awareness of institutional investors, globalization and acceleration of international capital movements, increase in competition, technological developments, and expectations in the social responsibilities of public companies and academic studies, corporate governance issues have gained increasing importance. In 1999, the "Corporate Governance Principles (KYI)" was declared by the OECD, after which studies and regulations gained momentum. Awareness on corporate governance in our country has started to emerge since 2002, and significant progress has been made so far.

The objective of this research is to examine the development of corporate governance regulations and practices in Turkish capital markets, to measure the compliance level of listed companies with non-mandatory KYI and their changes over the years, and to investigate the effect of the companies' trading time in the Stock Exchange on the Corporate Governance Maturity Levels.

In the study, the "**Corporate Governance Compliance Report (KYUR)**" notifications announced on the Public Disclosure Platform (KAP) between 2018 and 2021 were used. For the first time, the "**Corporate Governance Maturity Index (KYOE)**" calculation model was developed for Turkish capital markets for the measurement of the compliance level of the listed companies with the KYI, which are subject to the voluntary basis, both in general and in terms of the principles regarding Shareholders, Public Disclosure and Transparency, Stakeholders and BoD. It is considered that this index methodology can be an indicator that can be used in future academic studies. Also, it can be used as a metric both in providing value-added data to market stakeholders and in monitoring the "**Corporate Governance Maturity Levels" (KYOD)** of listed companies by the regulatory and supervisory authorities. In addition, the listed companies can direct their corporate governance structures by comparing the Corporate Governance Maturity Levels on a company basis with the sectoral index values.

In the study, it was also examined how the Corporate Governance Maturity of the companies, depending on the year they traded in the stock market, and how the time variable affected the corporate governance maturity in terms of the Shareholders, Public Disclosure and Transparency, Stakeholders, and BoD sections included in the report. Since it is the first academic study conducted in Turkey on this subject, it is considered that it will both contribute to the literature on the institutionalization process of listed companies and guide future academic studies.

2. CORPORATE GOVERNANCE AS A CONCEPT AND THEORY

2.1. Corporate Governance Concept and Development

From the industrial revolution to the present, the number of fields of study and the depth of knowledge in management has expanded rapidly. After the classical and neoclassical management periods, there has been a great increase in management models and theories that have developed with contemporary management approaches, especially since the mid-1970s. The Institutionalization Approach and the Agency Approach, which are among the management theories that developed in this process, formed the basis of important perspectives on corporate governance. Principles and concepts on Corporate Governance have been developed by working with shareholding structures and the development of competition. Considering important issues and targets such as global relations, competition, sustainability, and investor relations, especially for businesses of a certain scale, corporate governance maturity has gained a high level of importance. Today, global standards, which are described as KYI, are accepted all over the world and are the subject of many international studies. In this context, management structures, corporate processes, certain units and functions, and communication with shareholders in accordance with global standards are accepted as important audit, compliance, and maturity indicators for businesses.

In today's world where commercial relations and financial investments are carried out cross-border on a global scale, the reliability of businesses is measured not only by their financial statements but also by how well they comply with corporate governance regulations. In particular, various internationally accepted standards, scales, and indicators have emerged, which are expected to comply with the growth of enterprises, and if they go public. In this sense, the studies carried out by the OECD and the published G20/OECD KYI are accepted as important global standards.

In the Cadbury Report published in England in 1992, corporate governance was defined as the financial and other controls system by which a company is managed and controlled. (UNCTAD, 2003)

A large and growing body of literature has investigated this concept. In the study of Shleifer and Vishny (1997), it is stated that corporate governance is the way of providing a return on investments of those who provide finance to companies.

According to OECD (2016), corporate governance is a management approach that includes the relations between company management, the BoD, shareholders, and other stakeholders, and it also provides a structure in which how the company goals, tools to achieve these goals, and the performance will be monitored.

The purpose of corporate governance is expressed as providing the elements of **accountability, transparency,** and **trust** necessary to promote financial stability, long-term investment, and business integrity, thereby supporting the goals of strong growth and an inclusive society. (OECD, 2016)

After the 1990s, the importance of corporate governance gradually increased as a result of various company scandals, changes in the shareholding structure of companies, awareness of institutional investors, increased international capital movements due to globalization, developing competitive conditions, technologic improvements, expectations from public companies within the scope of social responsibility and increasing academic research. In the early years, the American Law Institute Report (1992), Cadbury (1992), Greenbury (1995), and Hampel (1998) reports in England, Hilmer Report (1993) in Australia, Vienot Report (1995) in France, King Report (1995) in South Africa, various studies as a guide on best practice examples in Hong Kong, Singapore, Malaysia, and other countries had a significant impact on the issue (Bilgiç, 1999).

In 1999, KYI have been prepared by the working group consisting of member country representatives by the OECD, especially for listed companies, to establish the institutional, legal, and regulatory framework regarding corporate governance, and to guide companies, stock exchanges, investors, and other relevant stakeholders in the development of the corporate structure. OECD KYI consist

of the rights and responsibilities of shareholders, the role of stakeholders, fair treatment of shareholders, disclosure and transparency, and duties and responsibilities of company management.

2.2. Basic Principles on Which Corporate Governance Is Based

2.2.1. Transparency

Transparency stands for presenting financial and non-financial information about the company to all stakeholders, especially shareholders, in a complete, accurate, understandable, and timely manner. **Establishing public confidence** is an important factor in the effective functioning of capital markets and the efficient distribution of capital, and therefore in the development of capital markets. The problem of asymmetric information in the capital markets, that is, the information imbalance between the parties of a transaction, is one of the issues that damage trust. (Bilgiç, 2014)

During the initial public offering, there may be differences in the level and content of information between the investors and issuer company. Also, information asymmetry exists also between the buyer and seller parties after the capital market instruments start to be traded on the stock exchange. This situation comes with it the challenges called **adverse selection problems** or **moral hazards**. With mandatory public disclosure regulations in capital markets, regulatory authorities determine and regulate the information that issuers must disclose to the public. Thus, the level of asymmetric information is tried to be kept at a low and acceptable level.

2.2.2. Fairness

Fairness means that the company management maintains an equal approach and treats all stakeholder groups equally, and treats different people and institutions in the same stakeholder group equitably. Equitable company management should consider the interests of shareholders and all other stakeholders and should treat all shareholders holding the same group of shares equally, including minority and foreign shareholders. Company management should treat not only shareholders but all other stakeholders in the same way, create an effective solution and compensation structure in case of violation of rights, encourage stakeholders to take a role in the organization and disclose information about the interests of stakeholders to the public. (UNCTAD, 2003)

2.2.3. Accountability

In the implementation of the principle of accountability, it is important to clearly define the duties and responsibilities within the company, to determine the accountability obligations in proportion to the powers given, and to have an effective and strong internal control structure as well as the existence of independent external audit mechanisms. (Alp and Kılıç, 2014)

Accountability at different levels and aspects, such as the accountability of the,

- BoD to the shareholders and stakeholders,
- Senior management to the BoD,
- Units within the company and their employees to the managers

should be defined and regulated within the company, and it should be ensured that the processes are carried out in accordance with these regulations.

2.2.4. Responsibility

The principle of responsibility implies that the company creates value for its shareholders and that it operates in accordance with laws and regulations, as well as social values, in this value-creation process. (Alp and Kılıç, 2014)

2.3. Development of Corporate Governance in Turkish Capital Markets

In 2002, following the announcement of the OECD KYI in 1999, studies on corporate governance in Turkish capital markets began, and significant progress has been achieved so far by going through important stages.

2.3.1. First Period Corporate Governance Studies (2002-2007 Term)

"Corporate Governance Best Practice Code: Structure and Functioning of the BoD", was the first study in Turkey, which was published by Turkish Industry and Business Association (TUSIAD) in 2002 and only focuses on the BoD dimension of corporate governance (Alp and Kılıç, 2014). By establishing a working group by the Capital Markets Board (CMB), both OECD Principles and other best practice examples were examined, and with the CMB's decision dated 04.07.2003 (No: 35/835), KYI were published especially for companies whose shares are traded in the Stock Exchange. In the first principles published by the CMB, according to the "comply or explain" principle, it was made mandatory for the listed companies to disclose to the public whether they apply the KYI or not, and if they do not, the reasons why should be explained. The principles consist of Shareholders, Public Disclosure and Transparency, Stakeholders, and BoD sections in line with the OECD Principles. With the CMB's decision dated 10.12.2004 published in the Bulletin numbered 2004/51 (No: 48/1588), concerning the minimum elements to be included in the corporate governance compliance reports of the listed companies, to be used as of the 2004 reports to be published in 2005. "Corporate Governance Compliance Report" format has been announced.

The Principles were revised and republished in light of updates made by the OECD in February 2005. In the OECD's report on "**Corporate Governance Pilot Study in Turkey"** published in 2006, the regulations that need to be made for the development of corporate governance practices in our country are explained. After this report, with the update made by the CMB in the rating communiqué,

the corporate governance rating has been included within the scope of the communiqué. (Alp and Kılıç, 2014)

2.3.2. Development Period Corporate Governance Regulations (2007-2012)

2.3.2.1. Changes in Capital Market Legislation

The process of implementing KYI in Turkish capital markets has progressed on voluntary basis until 2007. After 2007, regulations have been made by regulatory bodies to encourage good practices. Borsa Istanbul (BIST) (The previous title was Istanbul Stock Exchange) started to calculate the "BIST **Corporate Governance Index (XKURY)**", which shows their price return performance, by including companies with a score of at least 6 out of 10 with the KYI principles given by the rating agencies authorized by the CMB. In addition, Borsa Istanbul has started to apply discounts to the companies within the scope of the index in their annual listing/recording fees (50% for two years, 25% for the next two years, and 10% for the following years).

With Decree-Law No. 654 amending the Capital Market Law No. 2499 and published in the Official Gazette on October 11, 2011 (No: 28081 (Repeated)), it has given the CMB the authority to determine and announce the KYI, to require compliance with these principles in whole or in part, or to take measures in case of inconsistency. Thus, a period has begun when the principles will become mandatory from the principle of "comply or explain" in compliance with KYI. On the same date (No: 28081 (2. Repeated)), the Communiqué Serial: IV, No: 54 on Determination and Implementation of Corporate Governance Principles was published in the Official Gazette and became effective.

In Article 5 of the Communiqué, it is regulated that companies whose shares are traded in the stock exchange, except for the banks in the BIST 30 Index, are obliged to implement certain principles in the "Shareholders" section of the principles, and in that way some of the principles have been made compulsory for certain companies for the first time.

With the Communiqué Serial: IV, No: 56 on the Determination and Implementation of Corporate Governance Principles published in the Official Gazette dated 30.12.2011 (No: 28158), the scope of the mandatory KYI and the companies involved have been expanded with partnerships traded on the Stock Exchange (Except those in the Emerging Companies Market and the Watchlist Market).Within the scope of the Communiqué, also listed companies were divided into three groups according to their market values and actual free float amounts, and different obligations were imposed for each group.

2.3.2.2. Changes in the Turkish Commercial Code

In the new Turkish Commercial Code (TCC), which was put into effect on 01.07.2012, and in Article 1529, titled Corporate Governance Principles, in publicly traded companies, it is stipulated that the principles of disclosure to be made by the BoD and the corporate governance rating rules and results of the companies are determined by the CMB and that other public institutions and organizations can only make limited regulations in their own fields with the approval of the CMB.

With the new TCC, it has been regulated that shareholders will be treated equally under equal conditions, shareholding rights have been expanded, and new lawsuit rights have been granted. The non-transferable duties and powers of the general assembly were defined, and the privilege of voting at the general assembly meeting was limited. Electronic general assembly meetings have been paved for them to participate in the general assembly meetings and to exercise their rights easily, and the conditions regarding the limitation of share transfer have been aggravated. (Alp and Kılıç, 2014)

Regarding the BoD, the number and nature of the members have been determined, it has been defined in the articles of association that certain share groups and minorities can be represented, their inalienable duties and powers have been regulated, and the authority to establish committees and commissions has been given. The right to obtain information and examine the company's business and transactions has been ensured, the determination of its financial rights has been regulated, the concept of liability insurance has come, and the prohibition of making transactions with the company and borrowing has been introduced (Alp and Kılıç, 2014).

Concerning disclosure and transparency, the principles for the preparation and presentation of financial statements and annual reports to the general assembly have been regulated, an independent external audit structure has been introduced, companies have been regulated to open a corporate website on the internet and to allocate some of them to matters that require legal disclosure. (Alp and Kılıç, 2014) Regarding stakeholders, there have been regulations that protect the rights of employees/workers, and improve, expand, and secure the rights of creditors. (Alp and Kılıç, 2014).

2.3.3. Regulations Made After 2013

2.3.3.1. Changes in Capital Market Law and Communiqués

On 30.12.2012, the new Capital Markets Law (CML) numbered 6362, which repealed the CML numbered 2499, entered into force and the legal infrastructure was defined in more detail in compliance with KYI. The CMB has been given powers in determining and regulating the issues such as the content of the KYI, the scope of the corporate governance compliance report and its announcement to the public, corporate governance compliance rating, determining the procedures and principles of independent membership of the BoD, appointing members, exercising the powers of the general assembly under certain conditions in case the quorum of the BoD cannot be met and new members cannot be elected, appointing members, exercising the powers

of the general assembly under certain conditions (Alp and Kılıç, 2014).

After the amendments made in the CML, the Corporate Governance Communiqué and its annexed principles were published in the Official Gazette No. 28871 on 03.01.2014 and entered into force. The purpose of the Communiqué was to determine the procedures and principles regarding KYI and related party transactions. The Communiqué regulates the procedures and principles regarding pledges, guarantees, and mortgages, as well as the investor relations unit, and listed companies whose shares are traded in certain markets are held liable. In addition, companies are required to comply with certain KYI.

2.3.3.2. New Phase in Corporate Governance Compliance Reporting

Until 2019, BIST companies published their KYI compliance reports in pdf format within the annual reports on the KAP system. With the CMB mandating certain principles, new regulations on corporate governance with the new TCC, and the increase in the knowledge and adoption levels of listed companies on corporate governance, it has become necessary to analyze corporate governance compliance reports by regulatory authorities, investors, academics, and analysts.

Depending on the reporting period and the increase in the number of companies, the need to determine the compliance status of BIST companies with the principles and to compare them by market, sector, index, and years has come to the fore. For this, a project was initiated by the CMB with the European Bank for Reconstruction and Development ("EBRD"). CMB, EBRD, and Central Registry Agency (MKK) worked on technical developments to prepare a template for the announcement of corporate governance compliance reports on KAP in an analyzable and comparable Extensible Business Reporting Language (XBRL) format.

With the CMB decision (2/49) on 10.01.2019, it was announced that KYUR notifications should be made via the Corporate Governance Information Form (KYBF) template via KAP. Thus:

1) KYUR notification to report compliance with voluntary principles;
2) Reporting of KYBF templates and annual financial reports on KAP within the reporting period to inform about corporate governance practices was regulated.

Beginning with the 2018 year-end annual reports, announced in 2019, corporate governance reporting at KAP started with KYUR and KYBF notifications. The KYUR notification format has been created to monitor the level of compliance of the listed companies with the principles (Except Pre-Market Trading Platform, Watchlist Market, and Emerging Companies Market companies that were closed on 01.10.2020 and whose members were moved to the Sub-Market), the implementation of which is subject to a voluntary basis within the scope of the CMB Corporate Governance Communiqué. With KYUR, it is aimed to standardize and be comparable in public disclosure of corporate governance practices and to inform all relevant stakeholders. KYBF is designed to complement the information shared within the scope of KYUR and includes information on the practices of listed companies regarding all principles. (CMB, 2020))

3. DOMESTIC ACADEMIC STUDIES ON CORPORATE GOVERNANCE

3.1. SAHA World Corporate Governance Index

The World Corporate Governance Index (DKYE), calculated by Saha Corporate Governance and Rating Services Inc. (SAHA), consists of countries with a score of 60 or higher out of 100. In the 2021 update study, 150 countries were examined and classified into 5 groups according to their country grades.

In the updated study carried out by SAHA (2021), it was stated that the purpose of publishing the index in question was to be able to compare different countries in terms of corporate governance infrastructure and practices. International trade is increasing due to globalization. Compliance of international companies with investment, trade, or joint business with the KYI is related to the general level of corporate governance of the country in which they operate. For this reason, DKYE is important for companies doing international business.

In the DKYE methodology;

a) Corporate governance infrastructure and practices of 150 countries were comparatively examined.
b) It has been examined whether there is a corporate governance regulation in the countries in terms of social responsibility, independent board membership, privileges.
c) The establishment of the stock exchange in the relevant country, the existence of the corporate governance index, the existence of regulatory authorities for capital markets and financial institutions, and the situation of the country in political rights and personal freedoms were evaluated.
d) The corruption perception index was used to measure the business environment, and the existence of non-governmental organizations was investigated.
e) Score has been calculated for each country by weighting these components;
f) Countries were divided into 5 groups according to their scores, Group 1 was the highest, and Group 5 was the lowest, Group 1 and 2 were included in the index, and other groups were excluded.
g) It is stated that 37, 22, and 32 countries are included in Groups 3, 4, and 5, which are not included in the index, respectively. (SAHA, 2021)

Table 1. Countries in the DKYE Groups

	Group 1	Group 2
Explanation	Countries with a score of 80 and above	Countries with a score of 60-80
Number of countries	22	37
Countries	USA, Germany, Australia, Austria, Belgium, Denmark, Estonia, Finland, France, England, Sweden, Switzerland, Iceland, Japan, Canada, Korea, Latvia, Luxembourg, Hungary, Norway, Peru, **Turkey**	Argentina, Bosnia, and Herzegovina, Brazil, Bulgaria, China, Morocco, Philippines, South Africa, Georgia, India, Netherlands, Honduras, Spain, Israel, Italy, Qatar, Cyprus, Colombia, Costa Rica, Lebanon, Malaysia, Malta, Mauritius, Mexico, Egypt, Portugal, Singapore, Slovakia, Slovenia, Saudi Arabia, Chile, Thailand, Taiwan, Tunisia, Ukraine, New Zealand, Greece

Source: SAHA, 2021

3.2. The Study of The Borsa Istanbul

After the KYI announced by the CMB, the first comprehensive study on the status of the listed companies and their members was made by the BIST in 2001. A 71-question survey prepared based on the OECD's management principles and standards for joint stock companies was applied to determine the compliance status of the companies whose shares are traded and the intermediary institutions that are members of the BIST, and the quality of their practices. The survey questions are basically grouped under the following headings;

- Board members and independence,
- Transparency and relations with shareholders,
- Audit effectiveness,
- Relations with employees,
- Equal treatment of shareholders.

415 of 513 companies in total participated in the survey. 56 of the brokerage houses and 79% of the listed companies were included in the evaluation, so an analysis was made on a sample that reflects 70% of the BIST companies and member brokerage houses. In the study, the results of the survey between the manufacturing sector and the financial sector were also compared. The important findings of the study were as follows:

1. Most of the members of the BoD also work in companies within the group, and since they also hold other duties within the company, performance auditing, and management efficiency are insufficient.
2. In intermediary institutions, there is a high level of attention to the kinship relations between the members of the BoD and the partners.
3. Financial benefits are not provided to the members of the BoD based on performance.
4. Decisions of major partners/owners are effective in the appointment of senior managers.
5. Public disclosure practices are at a very good level.
6. Units performing an executive or advisory role in relations with partners are limited.
7. While the internal audit unit is common in intermediary institutions depending on the requirements of the legislation, it is not generally available in listed companies.
8. Share programs for company employees, foundation or fund applications for employees are very limited.
9. There are different groups in 17% of the listed companies and their members in terms of voting rights. Preferred shares are more common in companies than in members. Differences in voting rights and privileges are more common in the financial sector than in the manufacturing industry.
10. The distinction between the General Manager and the Chairman of the BoD has not been established.
11. There is no independent board member practice.
12. General Managers are professionals and they are mostly not assigned to other companies.
13. Board members can access the information they want.
14. The establishment of a special unit for the management of relations with partners is limited.
15. Companies that apply KYI and standards relatively better have higher financial and market return performance. (Tezcanli et al. 2001)

3.3. The Study Conducted by CMB

After the corporate governance reporting started to be published in XBRL format that can be analyzed in the KAP system in 2019, the "Monitoring Report" jointly prepared by the CMB, the EBRD, Nestor Advisors Ltd, and Ünsal Law Firm was published in 2020. The report is important because it is the first study on KYUR and KYBF disclosures published in new analyzable content, and it shows the progress in compliance with the KYI and practices of the listed companies.

The report has been prepared to encourage compliance with KYI, to encourage its implementation, and guide companies. Based on the 2018 year-end data of the companies traded in BIST 30 and BIST 100, the corporate governance reports were announced in 2019 (CMB, 2020). In addition, a sample group named "OTHER 70" was created to be used in the comparison of the companies in this sample. Compliance with non-mandatory principles in 2019 is 82.5% for BIST 30; 80% for BIST 100; 79.2% for OTHER 70.

Table 2. Compliance Levels of BIST Companies with Non-Mandatory Principles

Compliance Level	Average (%)		
	BIST100	BIST30	OTHER70
Yes	80.3	82.5	79.2
No	7.9	8.0	7.9
Partially	9.5	7.5	10.4

Source: CMB,2020

In the CMB report (2020), it is stated that the "Partly" option has the potential to fully comply with the principles, and if full compliance with these principles is achieved in the following years, the compliance rate for BIST companies will increase to 90%. In addition, for BIST 100 and 30, the lowest level of compliance was determined as "BoD", and the highest section was "Public Disclosure and Transparency" (CMB, 2020)

3.4. Studies on Company Performances within the Scope of the BIST Corporate Governance Index

Most of the literature on the capital markets in Turkey has been published on investigating the relationship between corporate governance compliance rating grades and stock market performances or financial performances. In these studies, besides the findings that it has a positive effect on stock returns, some results show no effect.

Eyüboğlu (2011) examined the effect of companies within the scope of XKURY on stock returns, using the data of 24 companies within the scope of the index. The stock returns of the companies for two periods (i. between initial public offering (IPO) and entry and the XKURY index, ii. between the entry to the XKURY index and December 2010) were analyzed. However, there was no significant difference between stock returns before and after entry into the index, and it was stated that it might be due to the small number of samples.

Sevimli (2021), studied on the relationship between corporate governance and organizational resilience, with 23 companies in the XKURY index in the 2017-2019 period and found that there is a high level of relationship between corporate governance and organizational resilience.

In her study, **Zengin (2014)** examined the relationship between the financial statement items and stock performances of 35 companies within the scope of XKURY between 2008 and 2013 by using the panel data analysis method before and after entry into the index with Tobin's Q ratio. A statistically positive and significant relationship was found between Tobin's Q, which is the dependent variable as an indicator of firm performance, and net dividend ratio, total debt/equity ratio, foreign shareholder ratio, and price/earnings ratio.

Yazgan (2017) examined the relationship between the announcement of the corporate governance rating of 58 companies within the scope of XKURY between 2011 and 2015 and their stock returns. It has been concluded that no abnormal returns can be achieved 10 days before and after the rating note is announced, and the market is efficient in a semi-strong form.

Tursun (2021) investigated the relationship between compliance with KYI and the financial performance of the banks whose shares are traded on the stock exchange. Between 2016 and 2020, the relationship between the return on assets of 12 banks and the ratio of women in the BoD, the size of the board, the ratio of independent members, the free float ratio, and the graduate education level of the Board members were examined. A positive and significant relationship was found between return on assets and female ratio in the BoD and total assets, but no significant relationship was found between other independent variables.

Soylu (2021) discussed performance measurement systems and KY applications in the study. As of 2019, the relationship between the financial and organizational performances of 18 companies in the XKURY index, excluding banks and insurance companies, and their corporate governance rating scores were examined. It was determined that there was a weak-moderate positive relationship between the grades at a 10% significance level. It has been evaluated that this may be due to the relevance of the company's financial performance to the sector and economy in which it operates, the inadequacy of the number of ratios used in the measurement of financial performance, the difficulty and complexity of reducing the corporate governance dimensions to a single note, and the adherence to bureaucratic and legal regulations that the improvements to be made in corporate governance practices should be spread over time.

In the research conducted by **Balkan** (2018) on 38 companies for the years 2005-2016, no result supporting the relationship between corporate governance and financial performance was found, and it was evaluated that this might be because the financial value of companies can be affected by many events unrelated to corporate governance.

In the study of **Yetgin** and **Ersoy** (2021), it was investigated whether the information on the inclusion of companies in the XKURY index caused abnormal returns, and in this context, stock market announcements regarding the inclusion of 59 companies in the XKURY index between 2007 and 2018 were examined. Whether it provides a statistically significant abnormal or cumulative abnormal return is made during the +/-10-day event window of the stock market's announcement date for indexing. As a result of the study, although there is a general increase in the share values of the companies that comply with the KYI, it has been determined that there is no relationship between the rating grades and share prices in the analysis of the years 2007-2008 due to the low number of observations, that there is a positive relationship in other years, and that companies with good Corporate Governance practices increase their stock market values.

4. ACADEMIC STUDIES ON COMPLIANCE WITH CORPORATE GOVERNANCE

Studies on corporate governance abroad are carried out in a wider perspective compared to the studies in our country.

In the study of **Gompers, Ishii,** and **Metrick (2003)** in their analysis of approximately 1,500 large companies based on the management index created in terms of investor rights, it was concluded that the market value and returns of companies that are more observant of investor rights are higher.

Wilkes (2004) emphasized that the measurement of the corporate governance concept on a company basis may be specific to the organizational structure and competitive strategy of the company.

Selvaggi and Upton (2008) examined the correlation between corporate governance and performance and return on shares in publicly traded companies in England during the 2003-2007 study period, and their findings indicated a positive relationship.

Berthelot, Morris, and **Morril (2010)**, on the other hand, found that stock investors also consider the corporate governance rankings of companies when evaluating share prices. According to the results of 289 companies examined in Canada between 2002 and 2005, they determined that the published corporate governance scores of the companies were not only related to market prices but also to accounting results.

Akinkoye and **Olasanmi (2014)** analyzed the corporate governance practices of non-financial companies in Nigeria in terms of KYI in the country, based on the data disclosed to the public by companies between 2003 and 2010 and created an index. In the study, it was revealed that the companies observed between the relevant years had an average level of compliance of 72.15 percent and there was a 5.83 percent growth at this rate over the years.

In a study conducted by **Abdallah** and **İsmail (2017)**, it was stated that there is a positive relationship between corporate governance and firm performance in firms where ownership is widespread and diversified.

As a result of the study of **Singh** and **Rastogi (2023)** on small and medium-sized companies in India, it has been determined that KYI can be used to improve the financial performance of companies of this size.

Rehman and **Hashim (2020)** examined the corporate governance maturity level of publicly traded companies in Oman and whether this maturity level differs in terms of the sector with the survey method. In the study, it has been determined that the level of maturity in corporate governance is measurable and that the level of maturity does not differ between different sectors. Apart from this study, there are studies based on surveys conducted with companies that examine corporate governance practices in different countries every year. (Hussain and Mallin, 2002; IFC and Hawkamah, 2008; Naser and Khadija, 2010)

5. EXAMINATION OF CORPORATE GOVERNANCE MATURITY LEVEL DEVELOPMENT OF EXCHANGE COMPANIES

5.1. Methodology

KYUR notifications, which include compliance with 68 voluntary principles within the scope of the CMB Corporate Governance Communiqué, announced by listed companies (excluding the Watch List Market and Pre-Market Trading Platform) on the KAP were used in the study. The four main sections of the KYI and the number of principles subject to voluntary disclosure are given in the table below.

Table 3. Distribution of Non-Mandatory Principles by Sections

Section Name	Number of Principles
Public Disclosure	5
Stakeholders	21
Shareholders	17
BoD	25
Total	**68**

The KYUR elements, the scope of which has been determined and announced by the CMB, can be answered in 5 different ways as "Yes", "No", "Partial", "Exempted" and "Not Applicable" for each principle. KYUR disclosures are of a quality that can measure compliance with the principles, and these notifications published on KAP website after the approval of the BoD of the company. Disclosed reports have been used by considering them to be reliable. KYUR notifications used in the 2018-2021 period are given in the table below.

The following steps were followed in the analysis process:

1) First of all, the answers given about compliance to each question in the KYUR notification announced on the KAP on an annual basis are noted as follows and the "**Corporate Governance Principle Score (KYIN)**" is calculated for each company in the sample. The difference between the intervals is used as 33.33 in the No and Partial options, and 33.34 in the Yes option. Exempted and Nor Applicable options are not included in the grading and average.
2) After converting the answers given on a company basis into grades, the "Corporate Governance Section Score" for each company based on 4 main sections was calculated with the formula below.

$$\mathbf{KYBN}_{(b,i,t)} = \left(\frac{\sum_{i=1}^{n} \mathbf{KYIN}_{(b,t)}}{\mathbf{m}} \right)$$

Table 4. Distribution of the Number of KYUR Notifications by Reporting Years and Sectors on the Basis of the Period of Trade on the Stock Exchange

Reporting Year and Sector Info		*BYear*=0*	BYear= 1	BYear= 2	BYear= 3	BYear= 4	BYear= 5+	Total
2018	Services	*0*	**4**	0	0	2	48	54
	Financial	*0*	**2**	1	0	2	103	108
	Industrial	*0*	**1**	0	1	1	147	150
	Technology	*0*	**1**	1	0	0	14	16
	Total	***0***	**8**	**2**	**1**	**5**	**312**	**328**
2019	Services	***0***	**2**	4	0	0	49	55
	Financial	***0***	**0**	2	1	0	104	107
	Industrial	***0***	**1**	1	0	2	149	153
	Technology	***1***	**2**	1	1	0	13	18
	Total	***1***	**5**	**8**	**2**	**2**	**315**	**333**
2020	Services	***0***	**3**	2	4	0	50	59
	Financial	***0***	**0**	0	2	1	105	108
	Industrial	***1***	**3**	2	2	0	141	149
	Technology	***0***	**1**	2	1	1	13	18
	Total	***1***	**7**	**6**	**9**	**2**	**309**	**334**
2021	Services	*2*	18	3	2	4	53	82
	Financial	*0*	9	0	1	2	110	122
	Industrial	*1*	16	3	1	2	151	174
	Technology	*0*	6	1	2	1	15	25
	Total	***3***	**49****	**7**	**6**	**9**	**329**	**403**
2018-2021	**Services**	***2***	***27***	***9***	***6***	***6***	***200***	**250**
	Financial	***0***	***11***	***3***	***4***	***5***	***422***	**445**
	Industrial	***2***	***21***	***6***	***4***	***5***	***588***	**626**
	Technology	***1***	***10***	***5***	***4***	***2***	***55***	**77**
	Total* (Calculated)**	***5 (-)***	**69**	**23**	**18**	**18**	**1265**	**1398**
			(69)	**(23)**	**(18)**	**(18)**	**(1265)**	**(1393)**

** BYear (b_yil)=0,1,2,3,4,5+ values describes the trading period of the reporting company in the Stock Exchange in years. The number of reports in the BYear=0 column means that the company initially offerd to public reported in the same year. Since the companies do not have a reporting obligation in the year of the public offering, the KYUR notification of 5 companies that reported to the KAP in their first year on the stock exchange was not included in the analysis in this study. Therefore, analysis studies were carried out on 1396 reports.*

*** Report numbers in the BYear=1 column show the reporting 1 year after the IPO. In other words, if all of the publicly offered companies publish KYUR, it gives the total number of publicly offered companies in the relevant year. For example, although 52 companies went public in 2021, the number of KYURs being 49 means that the 3 companies that went public in 2021 do not have a KYUR statement for 2021 that should be published in the first quarter of 2022.*

**** Looking at the BYear columns, the sector-based data size has not been sufficiently formed, especially for companies that have been traded in the stock market for 2, 3, or 4 years (BYear = 2,3,4). In this study, the analysis of the effect of the trading time on the Stock Exchange on the KYOD was examined not by sector, but by the total number of all companies. (Since the reporting has been done for 4 years, as the number of publicly traded companies from different sectors increases, the KYOD impact analysis of the period of being traded in the Stock Exchange in the coming years can also be looked at on a sectorial basis)*

KYBN : Corporate Governance Section Score
KYIN : Corporate Governance Principle Note
b : Relevant Subsection in the Report
i : Company
n : Number of Companies
m : Number of Scored Principles in the Section
t : Year

3) It has been regulated that the weighting according to the sections will be applied as follows in the corporate governance compliance rating with the CMB's principle decision dated 01.02.2013 and numbered 4/105

a. Shareholders 25%
b. Public Disclosure and Transparency 25%

Table 5. The Weights of KYUR Answers

Response	Score
Yes	100
Partial	66.66
No	33.33

c. Stakeholders 15%
d. BoD 35%

In the study, the Corporate Governance Maturity Level (KYOD) of each company was calculated by weighting and summing the grades related to the sub-sections with the relevant coefficients mentioned above.

$$\mathbf{KYOD_{(i,t)} = (0.25 * KYPS_{(i,t)}) + (0.25 * KYKA_{(i,t)}) + (0.15 * KYMS_{(i,t)}) + (0.35 * KYYK_{(i,t)})}$$

$KYOD_{(i,t)}$: (i) Company's Corporate Governance Maturity Level
$KYPS_{(i,t)}$: Shareholders Principles' Section Note
$KYKA_{(i,t)}$: Public Disclosure Principles' Section Note
$KYMS_{(i,t)}$: Stakeholders Principles' Section Note
$KYYK_{(i,t)}$: BoD Principles' Section Note
t: Year

4) In the following stage, the average of the KYOD was taken and the "**Average Corporate Governance Maturity Level**" for all the BIST companies was calculated as an index value on a year-based basis for the sectors.

$$\mathbf{KYOE_{(t)} = \left(\frac{\sum_{i=1}^{n} KYOD_{(i,t)}}{n}\right)}$$

KYOE: Corporate Governance Maturity Index
t: The year in which the index calculation was made
n: Number of companies in the index

KYOE can take a maximum of 100 and a minimum of 33.33. In the calculation of the index, the KYURs disclosed to the public on KAP were used as of the calculation date, and the updates made in these reports after the announcement were not taken into account.

5) The index value of BIST companies in terms of KYUR sections is also calculated.

$$\mathbf{SectionKYOE_{(b,t)} = \left(\frac{\sum_{i=1}^{n} KYBN_{(b,t)}}{n}\right)}$$

KYBN(b, t): (b) Company's (t) Year Corporate Governance Section Score
t: The year in which the index calculation was made
n: Number of companies in the index

KYPSOE, KYMSOE, KYKAOE, KYYKOE: It is used for the Maturity Index calculated for the Shareholders, Stakeholders, Public Disclosure, and BoD sections, respectively, from the Corporate Governance sections.

$$\mathbf{KYPSOE_{(b,t)} = \left(\frac{\sum_{i=1}^{n} KYPS_{(b,t)}}{n}\right)}$$

$$\mathbf{KYMSOE_{(b,t)} = \left(\frac{\sum_{i=1}^{n} KYMS_{(b,t)}}{n}\right)}$$

$$\mathbf{KYKAOE_{(b,t)} = \left(\frac{\sum_{i=1}^{n} KYKA_{(b,t)}}{n}\right)}$$

$$\mathbf{KYYKOE_{(b,t)} = \left(\frac{\sum_{i=1}^{n} KYYK_{(b,t)}}{n}\right)}$$

6) In the last stage, the effect of the yearly trading time of the listed companies on the KYOD value was examined with a one-way analysis of variance. Tukey HSD analysis was applied in multiple comparison tests to reveal the difference between the mean of the treatment time, that is, the KYOD values. (Demir, 2020) The analysis was repeated based on KYUR subsections.

5.2. Analysis and Findings

5.2.1. KYOD Analysis and Findings by Trading Duration on the Stock Exchange

Table 6. KYOD Value Comparison by Trading Duration on the Stock Exchange

BYear	N	KYOD	Standard Deviation	Sd	F	p
1	69	85.97	5.43	4; 1391	8.833	0.000
2	23	88.73	4.80			
3	18	89.21	5.23			
4	18	88.20	5.70			
5+	1265	89.28	4.48			
Total	1393	89.09	4.61			

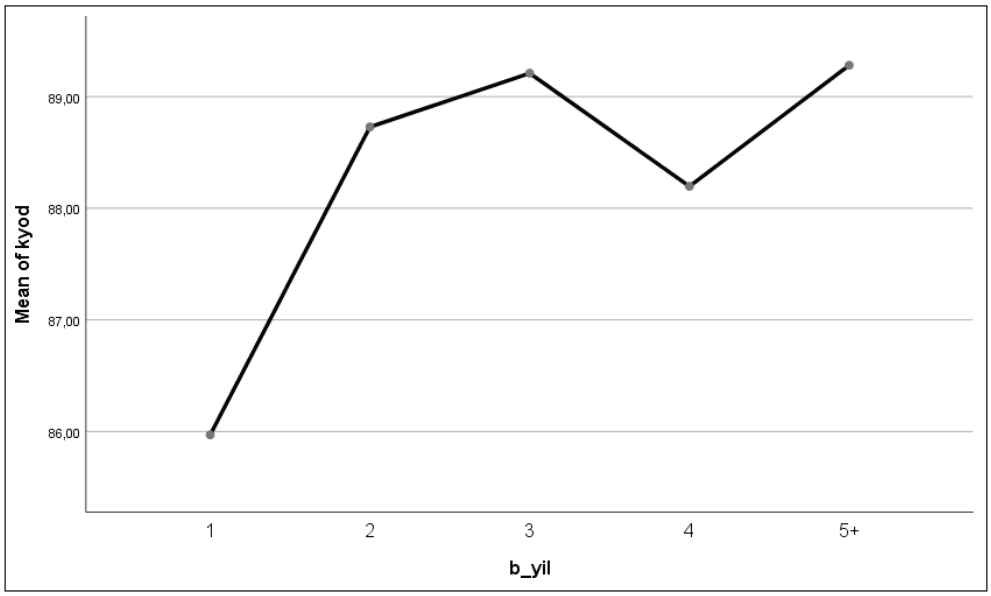

Figure 1. KYOD Value Change Chart by Trading Duration the Stock Exchange.

When the difference between the averages of the KYOD values according to the trading duration on the stock exchange every year was examined, it was found that there was a statistical difference between the averages (F4; 1391=8.833; p<0.05). According to the results of Tukey HSD analysis which aimed to determine the difference between the averages, the results point out that the KYOD value of the companies with a trading period of 1 year in the stock market is lower than the companies that have been traded for a longer period.

It is seen that the KYOD value is at a low level (approximately 86) in the first KYUR made by the companies following the year they started to be traded on the stock exchange. In the ongoing second-year reporting results, a significant increase toward 90 stands out. In the third year, the upward trend continues, and it is seen that the rate of increase in KYOD has decreased even though it has exceeded the value of 90. In the fourth year, it was observed that the KYOD value dropped a little and fell to value of 89. It can be interpreted that the reason for this is that the companies have a higher level of sensitivity in terms of compliance with the principles in the first 3 years following the IPO, and then they start to behave more flexibly in their handling of the principles and processes compared to the first three years. Therefore, in the fourth year, we can say that the sensitivity of the listed company to comply with the KYI, has decreased compared to its first 3 years of public service. When we look at the following years (5+ years), we can say that the company has started to make compliance with KYI a management culture, so corporate governance development continues, but the improvement has turned into a well-established upward trend, although the rate of increase in KYOD has slowed down.

5.2.2. KYPS Value Analysis and Findings by Trading Duration on the Stock Exchange

In the one-way analysis of variance, it was found that there was a statistical difference between the mean KYPS values of the companies according to their years of existence in the stock market (F4; 1391=18.958; p<0.05). According to the results of the Tukey HSD analysis, the average values of the companies 1 year after they started to be traded on the stock exchange were lower than the other years.

After going public, new investors are formed in the stock market, and issues such as the protection of the rights of new shareholders, the distribution of profits, and the correct execution of processes such as the general assembly

Table 7. KYPS Value Comparison by Trading Duration on the Exchange

BYear	N	KYPS	Std.Deviation	Sd	F	p
1	69	87.29	6.74	4; 1391	18.958	0.000
2	23	91.58	3.43			
3	18	90.07	5.20			
4	18	91.01	3.54			
5+	1265	91.76	4.04			
Total	1393	91.50	4.32			

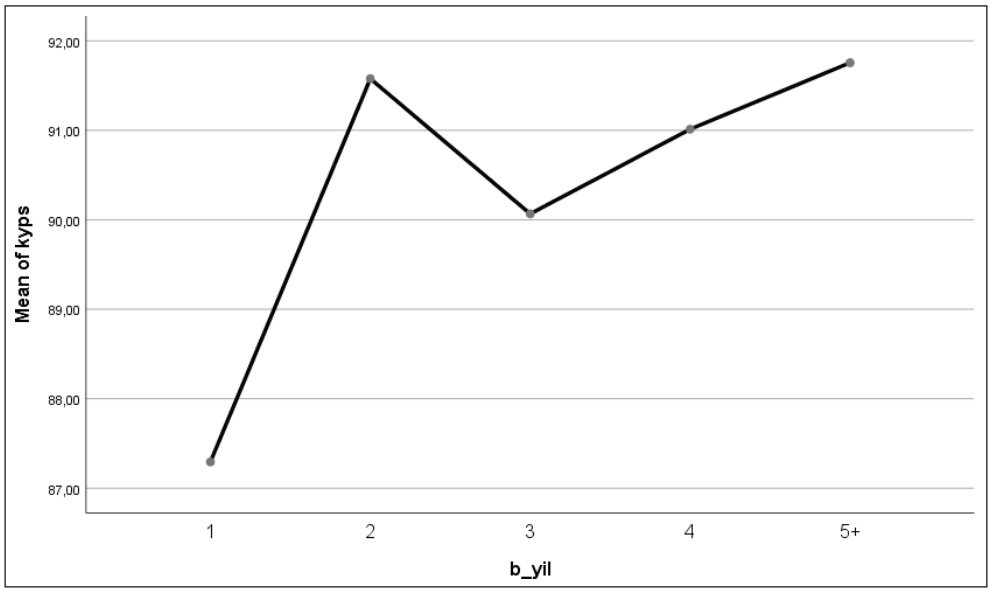

Figure 2. KYPS Value Change Chart by Trading Duration on the Stock Exchange.

are handled most sensitively. Therefore, as a publicly traded company, the KYPS value for the shareholders is 87 in the first year after the report, while it rises to approximately 92 in the second year. In the third year, it regresses to the 90s. The decrease in the KYPS value, which is noticeable in the third-year reporting after the first two years, may be the result of the flexibility of the sensitivity in the first 2-3 years after the IPO. However, as in the general trend, we can say that the upward trend in KYPS value has entered a relatively slow but continuous recovery process since the fourth year.

5.2.3. KYKA Value Analysis and Findings by Trading Duration on the Stock Exchange

It was found that there was a statistically significant difference between the averages of KYKA values according to the years of being in the stock market. (F4; 1390=3.097; $p<0.05$). According to the Tukey HSD multiple comparison tests, the average values of the companies 1 year after they started to be traded on the stock exchange were lower than the other years. In addition, the average obtained as a result of being in the stock market after 4 years was lower than the average of 2 and 3 years of being in the stock market.

Public Disclosure is an important section for publicly traded companies such as the Shareholders Section. Particularly, the section value for public disclosure, which is in the range of 90-96, draws attention to the fact that KYKA is quite high. Since KAP notifications are always handled with the most precision starting from the public offering process, KYKA already starts with a relatively high level of maturity with a value above 90 even in the first year reporting. In the second and third years, it rises to the 95-96 range and remains quite high. However, the KYKA value also decreases in the fourth year and reaches 92 levels. The reason for this can be interpreted as the stretching of the sensitivity shown by the companies in the first 2-3 years after the third year. Afterward, starting from the fourth year and for companies with 5+ years, the KYKA value continues to develop in the range of 92-93 even though the rate of increase decreases.

5.2.4. KYMS Value Analysis and Findings by Trading Duration on the Stock Exchange

In the results of a one-way analysis of variance regarding whether there is a difference between the averages of the KYMS values according to the period of trading on the

Table 8. KYKA Value Comparison by Trading Time Stock the Exchange

BYear	N	KYKA	Std. Deviation	Sd	F	p
1	69	90.07	8.37	4; 1390	3.097	0.015
2	23	95.07	7.84			
3	18	95.18	8.50			
4	18	92.22	9.22			
5+	1264*	92.67	7.49			
Total	1392	92.61	7.60			

** Since this section is missing in a company report, the number is one less than the other sections.*

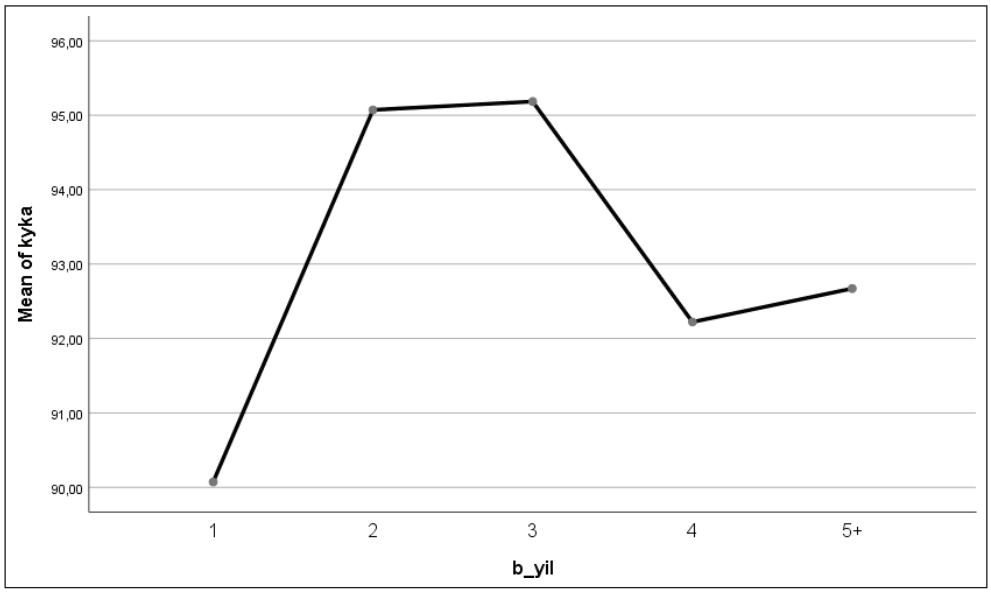

Figure 3. KYKA Value Change Chart by Trading Duration on the Stock Exchange

Table 9. KYMS Value Comparison with the Last Year in the Stock Exchange

BYear	N	KYMS	Std. Deviation	Sd	F	P
1	69	89.21	8.35	4; 1391	3.573	0.007
2	23	88.16	9.72			
3	18	89.71	10.61			
4	18	88.76	10.64			
5+	1265	91.71	7.63			
Total	1393	91.47	7.82			

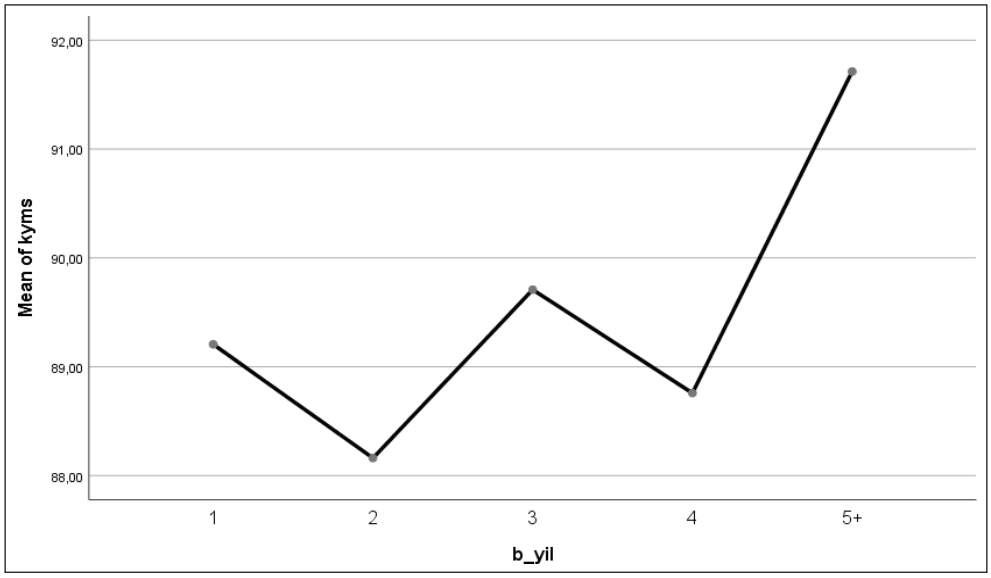

Figure 4. KYMS Value Change Chart by Trading Duration on the Stock Exchange.

Table 10. KYYK Value Comparison by Trading Duration on the Stock Exchange

BYear	N	KYYK	Std. Deviation	Sd	F	p
1	69	80.71	7.14	4; 1391	5.746	0.000
2	23	82.41	5.51			
3	18	84.12	5.46			
4	18	83.07	6.52			
5+	1265	84.10	5.91			
Total	1393	83.89	6.01			

stock exchange every year, it was found that there was a statistical difference between the averages (F4; 1391=3.573; p<0.05). According to the Tukey HSD analysis, the average values in the first four years were lower than the values of being traded in the stock market for 5 years or more.

If we look at the Stakeholders section of the KYI, we see the KYMS value in the range of 88-92. While KYMS was in the range of 89-90 in the first year, it draws attention as the only value that decreased in the second year and regressed to 88 and again increased to the 89-90 band in the third year. In the fourth year, a downward trend is also seen in the KYMS value, as in KYOD and other sections. Issues related to stakeholders require radical changes that will take time, such as institutional transformation, as they regulate the rights and conditions of the affected company and employees, social responsibility, etc., which affect customer satisfaction, production and quality processes, supplier relations, organization, and human resources. Therefore, while the fourth year is in the range of 88-89, a significant improvement is remarkable with an increase to approximately 92 as it progresses to 5+ years.

5.2.5. KYYK Value Analysis and Findings by Trading Duration on the Stock Exchange

According to the results of a one-way analysis of variance, a statistically significant difference was found between the averages of KYYK values according to the years of trading in the stock market (F4; 1391=5.746; p<0.05). According to the Tukey HSD multiple comparison tests, it was seen that the mean values increased as the years increased in the KYYK values.

When we look at the results of the KYI regarding the BoD, it is seen that it is relatively lower than the other sections in the 80-85 value range. In the second and third years, it rises to a value in the range of 84-85 with a significant increase. However, although the decrease in the KYYK value in the fourth year draws attention, it barely reaches the level of 83. After 5+ years, it rises above the value of 84 with an established upward trend and continues to rise towards the value of 85. The maturity level and values of the KYI for the BoD stand out as the weakest part in compliance with the KYI.

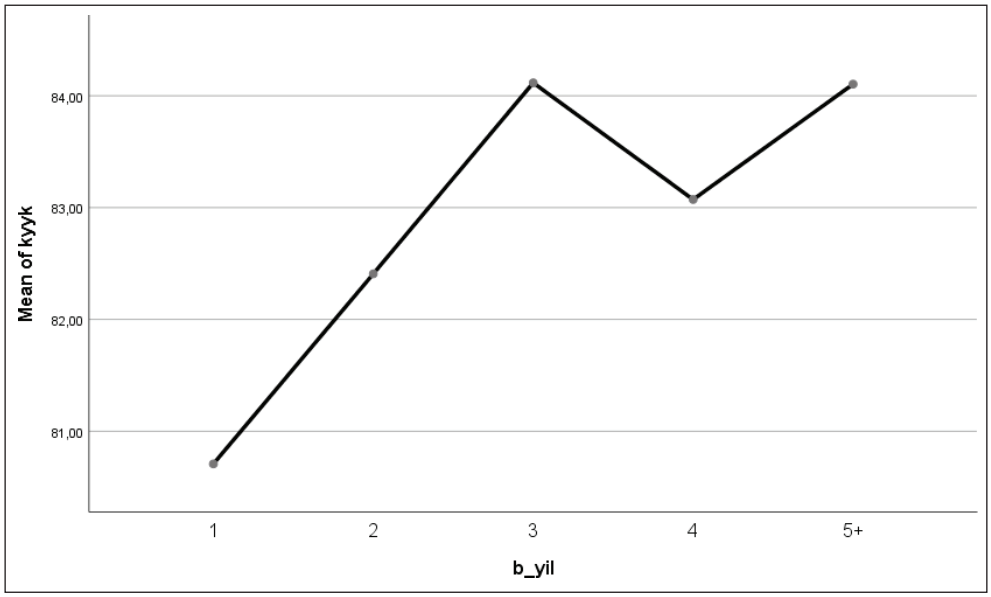

Figure 5. KYYK Value Change Chart by Trading Duration on the Stock Exchange.

Table 11. Values of KYOE and Maturity Indices for Corporate Governance Subsections by Years for All Companies and Sectors

2018-2021 SectionKYOE and Averages (KYOE)	2018				2019				2020				2021			
	KYPSOE	KYKAOE	KTMSOE	KYYKOE	KYPSOE	KYKAOE	KTMSOE	KYYKOE	KYPSOE	KYKAOE	KTMSOE	KYYKOE	KYPSOE	KYKAOE	KTMSOE	KYYKOE
All Companies Avg.=KYOE	91.79	92.20	91.49	83.94	91.81	92.64	91.44	83.88	91.58	93.13	91.79	84.12	90.77	92.33	91.14	83.49
	89.10				89.12				89.39				88.67			
Industrial Avg. =KYOE	*91.89*	*91.70*	*93.14*	*83.83*	*92.01*	*92.29*	*93.12*	*83.77*	*91.73*	*92.91*	*93.24*	*83.93*	*91.01*	*92.43*	*92.54*	*83.29*
	89.21				89.36				89.52				88.89			
Financial Avg. =KYOE	*91.85*	*92.64*	*90.02*	*84.18*	*91.98*	*93.03*	*89.99*	*84.17*	*91.80*	*93.69*	*90.35*	*84.30*	*91.19*	*92.93*	*89.89*	*84.15*
	89.09				89.21				89.43				88.97			
Services Avg. =KYOE	*91.50*	*93.02*	*89.93*	*83.30*	*91.83*	*93.52*	*89.72*	*83.74*	*90.75*	*93.16*	*90.86*	*83.82*	*89.56*	*91.18*	*90.27*	*83.03*
	88.78				88.68				88.94				87.79			
Technology Avg. =KYOE	*91.40*	*91.25*	*91.29*	*85.42*	*89.09*	*90.74*	*91.07*	*83.56*	*91.82*	*91.48*	*91.36*	*85.54*	*91.05*	*92.53*	*90.23*	*83.24*
	89.25				87.86				89.47				88.56			

5.2.6. Maturity Indices and Analysis

The values obtained in the calculations of KYOE 2018-2021 are given in the table above. In Figure 6 below, the trend of KYOE values by years based on all companies and sectors is seen. In 2021, when the public offering is intense (see Table 4), a significant decrease is observed in all sectors and the general index.

When the 2018-2021 values of the Corporate Governance section indices (KYPSOE, KYKAOE, KYMSOE, KYYKOE) are examined, the trends seen in Figure 7 emerge. For the same reason, there is a downward trend in the indexes of all sections of the KYI, due to the high number of new companies that went public in 2021.

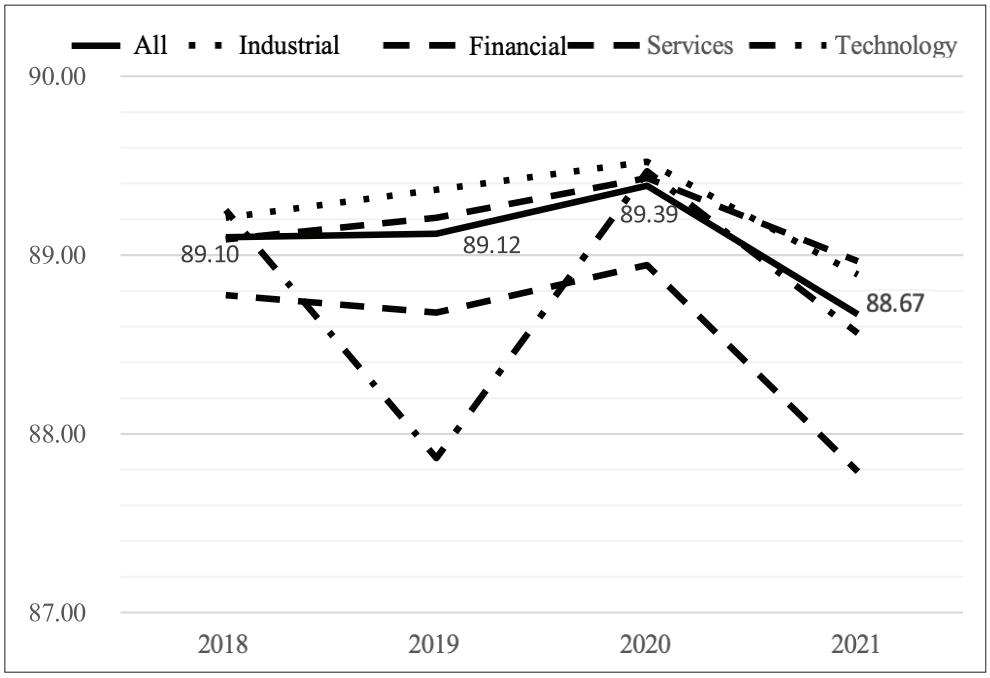

Figure 6. Corporate Governance Maturity Indices for All Companies and Sectors.
(The values of both graphs can be viewed in the table above.)

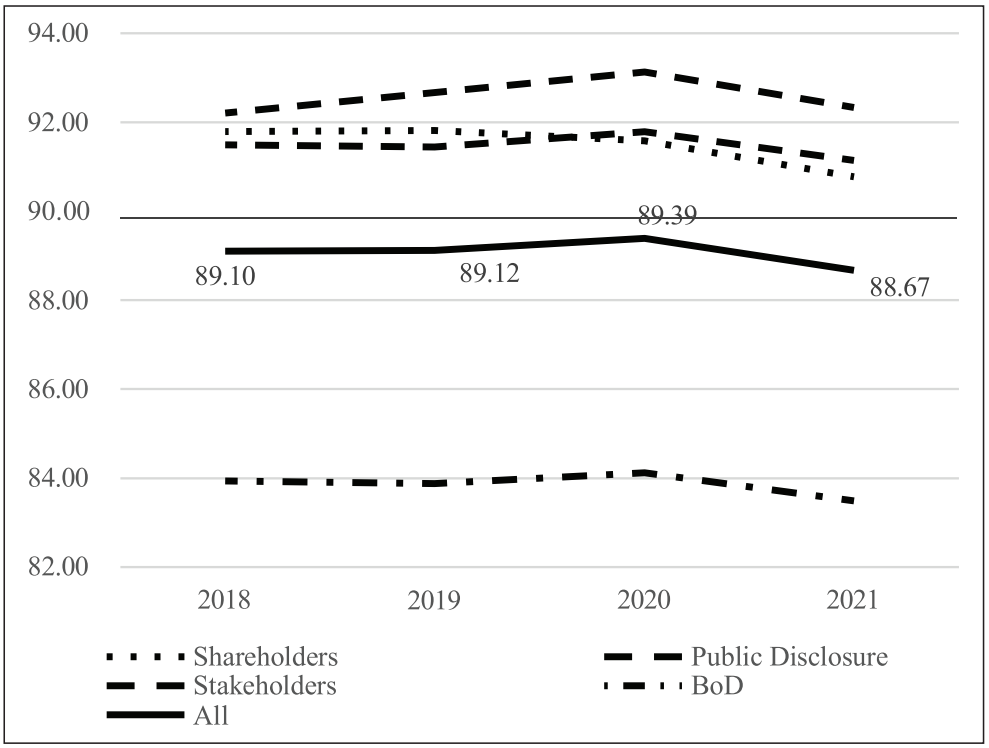

Figure 7. Section KYOE for All Companies.

6. CONCLUSION, DISCUSSIONS AND RECOMMENDATIONS

In this study, the development of corporate governance regulations and practices in Turkish capital markets was examined, and it was aimed to measure the compliance level of listed companies with the non-mandatory KYI and their changes over the years and to investigate the effect of the companies' trading duration on the corporate governance maturity levels. Thus, the study to add a different dimension to academic studies on corporate governance.

Within the scope of the study, the KYUR notifications announced by the listed companies in the KAP between the years 2018-2021 were examined. The KYOE calculation model has been developed as an index value for the measurement of the level of compliance with KYI.

Previous studies on corporate governance in our country generally discuss relationship between the corporate governance rating scores of the companies in the XKURY index and their stock market performance or financial performance. However, when the literature on corporate governance is analyzed at the global level, it is seen that different studies are carried out with a wider perspective compared to our country, and there are studies on the measurement of corporate governance maturity as well as studies on the measurement of the relationship between good corporate governance practices and market value and return. Nonetheless, it is seen that these studies are based on surveys conducted with companies rather than structured data sets that examine corporate governance practices every year, revealing the current level of corporate governance practices of the countries or regions within the scope of the research, but do not reveal the changes in compliance over time and the causes and consequences of these changes.

For the first time in our country, the level of compliance of listed companies with the general principles and the sections discussed under four headings was measured with the KYOE model is provided with this study, and it is thought that this model can be used as a metric in future academic studies. In addition, it is considered that it can be used as an index value by the regulatory and supervisory institutions of our capital markets both in supplying value-added data to market stakeholders and in monitoring the corporate governance maturity levels of listed companies. By using the aforementioned methodology, the Corporate Governance Maturity Level scores, which will be calculated on a company basis, can also be compared with the sectorial index values, thus giving direction to the corporate governance structures of the listed companies.

As a result of the study, it has been seen that the KYOE values of the listed companies tend to increase in 2018-2020 and decrease in 2021 due to the high number of companies that have started to be traded on the stock exchange. The increase in corporate governance maturity of listed companies every year is also consistent with the results of the Akinkoye and Olasanmi (2014) study, which used a methodology similar to the index methodology in our study.

When analyzed on a sectorial basis, the KYOE value for industrial companies is above the stock market average, while it is below the stock market average in the services sector.

When analyzed in terms of the KYI sub-sections, it has been determined that the index value of public disclosure is higher than other sections, and the index value of the BoD section is the lowest.

In addition, the effect of the duration of trading on the stock exchange after the public offering on the Corporate Governance Maturity Level was also examined in the study. Since it is the first academic study conducted in our country on the effect of the companies' trading time on the stock exchange on the corporate governance maturity levels, it is considered that it will both contribute to the literature on the institutionalization process of stock exchange companies and serve as guidance future academic studies.

By analyzing the maturity levels of the general and sub-sections of the KYI, depending on the period they are traded in the stock exchange significant results were obtained. In general, after the companies went public, there was an improvement in the Corporate Governance Maturity Level based on the previous year in the stock market. There has been an increase in the level of corporate governance compliance in the first 3 years after the public offering. A decrease was observed in the 3rd and 4th years, and after the 5+ years, although the rate of increase in the first three years decreased, it was observed that there was a regular development trend. Since the number of new public offerings was high in 2021, the effect of new companies that lowered the Corporate Governance Maturity Level and the overall index was clearly seen.

When KYI are analyzed based on sub-sections, it can be seen that there are different trends in their development. It has been observed that the principles regarding public disclosure and transparency, as well as shareholders, have been handled more sensitively by companies since the public offering and their compliance values are higher. It is noteworthy that compliance with the principles regarding stakeholders has achieved a steady rise over a longer period. On the other hand, the level of maturity in the section regarding the BoD is at a lower level. To determine the reasons for this situation, it is thought that issues such as the relationship between executive roles and the BoD of listed companies, the structure and functions of the board in family companies, effects of various professions, and female/male representation ratio in the BoD, the independence of the members, the working principles and practices of the subcommittees should be considered among the topics that can be researched in future academic studies.

The findings of this study shows that it is important to examine the effect of the period of trading on the stock exchange on the Corporate Governance Maturity Level from a sectorial perspective. However, because the sectorial distribution of KYUR numbers published in the 1st, 2nd, 3rd, and 4th years following the public offering of companies in the current situation is not sufficient for analysis, this examination could not be made. This is an important issue for future research and can be among the potential research topics for the future that the development of KYOD is analyzed separately, both based on the general average and the KYI sub-sections, by sector, when the number of KYUR notifications of the companies that have passed 1-4 years since they started to be traded on the stock exchange increases and the data size reaches a sectorally analyzable size. There is abundant room for further progress in this area and it could be argued that our findings on the effect of the period of trading on the stock exchange on the Corporate Governance Maturity Level of the companies will also contribute to the foreign literature.

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