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COMPARISON OF INNOVATION CAPACITIES OF MANUFACTURING SECTORS OF OECD MEMBER COUNTRIES

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Abstract

The aim of this study is to analyze the innovation capabilities of the manufacturing sectors in Turkey and selected Organisation for Economic Co-operation and Development (OECD) countries and compare them on a national basis. The literature was primarily searched and 18 criteria were determined to be used for comparison in the study. The CRITIC method was used to determine the criterion weights. Then, using the EDAS method, countries were ranked according to the innovation performance of their manufacturing sectors. According to the results of the analysis using the According to the results of the analysis using the EDAS method, the United States, the United Kingdom, and Finland are in the first three places, while Poland, Hungary, and Chile are in the last three places. Comparison of Innovation Capacities of Manufacturing Sectors of OECD Member Countries.

Key Words ***:*** *Innovation, Manufacturing Sector, CRITIC, EDAS, OECD.*

Jel Classification ***:*** *C44, O31.*

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OECD ÜYESİ ÜLKELERİN İMALAT SEKTÖRLERİNİN İNOVASYON KAPASİTELERİNİN KARŞILAŞTIRILMASI

Öz

Bu çalışmanın amacı, Türkiye ve seçilmiş Ekonomik İşbirliği ve Kalkınma Teşkilatı (OECD) üyesi ülkelerdeki imalat sektörlerinin inovasyon yeteneklerini analiz etmek ve ulusal bazda karşılaştırmaktır. Öncelikle literatür taranmış ve çalışmada karşılaştırma için kullanılacak 18 ölçüt belirlenmiştir. Kriter ağırlıklarının belirlenmesinde CRITIC yöntemi kullanılmıştır. Ardından, EDAS yöntemi kullanılarak ülkeler imalat sektörlerinin inovasyon performansına göre sıralanmıştır. EDAS yöntemi kullanılarak yapılan analiz sonuçlarına göre Amerika Birleşik Devletleri, Birleşik Krallık ve Finlandiya ilk üç sırada yer alırken son üç sırada Polonya, Macaristan ve Şili yer almaktadır. Türkiye ise 20. sırada yer almaktadır. Bu itibarla Türkiye, Slovakya, İtalya, Avustralya, Japonya, Kore Cumhuriyeti, İspanya, Letonya, Polonya, Macaristan ve Şili'den daha üst sıralarda yer almaktadır

Anahtar Kelimeler ***:*** *İnovasyon, İmalat Sektörü, CRITIC, EDAS, OECD.*

Jel Sınıflandırması ***:*** *C44, O31.*

INTRODUCTION

The manufacturing sector is associated with almost all areas of the economy and is one of the sectors with the highest multiplier effects (Herman, 2016). It is seen in many studies in the literature that the manufacturing sector is the cornerstone of many national economies (Chakravarty & Mitra, 2009: 22–23; Dasgupta & Singh, 2005; Haraguchi, Cheng, & Smeets, 2017; Heredia Pérez, Geldes, Kunc, & Flores, 2019; Li, Xue, & Huang, 2018; Shen, 2012; Szirmai & Verspagen, 2015). The main views are emphasized that the manufacturing sector is an important sector with the ability to represent structural change, productive jobs (Herman, 2016: 976) and the creation of sustainable economic growth (Herman, 2016: 976; Reynolds & Uygun, 2018). The manufacturing sector leads the economic growth of Turkey, as in other countries, and constitutes 94.9% of total exports (TUIK, 2021) as the driving force of exports.

Apart from small financial heaven countries and a few oil-rich countries, almost no country has achieved and maintained high living standards without making significant improvements in the manufacturing sector (Haraguchi et al., 2017: 294). Therefore, the role of the manufacturing sector, which plays a key role in the economic development of developing countries in general (Haraguchi et al., 2017: 293), cannot be ignored. Although the manufacturing sector is a very important sector for countries, attempts are made to cope with many difficulties such as globalization (Aluko, Akinola, & Sola, 2004: 119), intense competition (Lacom, Bazzaro, & Sagot, 2017), environmental restrictions (Golini & Gualandris, 2018; Leiter, Parolini, & Winner, 2011; Rassier & Earnhart, 2015, pp. 129–130; Rubashkina, Galeotti, & Verdolini, 2015, pp. 288–289), increased unit labor costs (Cho, Leem, & Shin, 2008, pp. 840–841; Wang, Xia, & Xu, 2020), financial factors (Naidu & Chand, 2012), global or national economic crises (Cho et al., 2008, pp. 840–841; Onaran, 2009), Epidemics such as COVID-19 (Chakraborty & Biswas, 2020; Okorie et al., 2020; Rani, Mishra, Krishankumar, Ravichandran, & Kar, 2021; Teresiene et al., 2021, pp. 159–160), and many difficulties created by political factors.

To overcome these challenges, manufacturing industry representatives must attach importance to innovation not only in the manufacturing process, but also in all processes including planning, design, purchasing, procurement (logistics), processing, sales, after-sales service, and customer management (Cho et al., 2008, pp. 840–841); because innovation in the manufacturing industry, which plays a critical role in the economic development of countries and in increasing the competitiveness of companies (Madrid-Guijarro, Garcia, & Auken, 2009: 466), is seen as a factor contributing to higher performance and strengthening the competitive advantage of the firm. However, the fact that production innovation is necessary should not be ignored to combat shortening product life cycles and take advantage of new opportunities (Cho et al., 2008: 841).

In various studies, innovation in the manufacturing sector has been stated as the most fundamental resource for the success and survival of the company (Rajapathirana & Hui, 2018) and it has a strategic importance for countries in their efforts to reshape the technology of the future (Jiang, Zhang, Bu, & Liu, 2018; Rajapathirana & Hui, 2018). In addition, the need to protect and build manufacturing capacities to support economic growth and development (Madrid-Guijarro et al., 2009: 466) was emphasized in some studies and the power of a country as well as a region in production was linked to its ability to innovate (Reynolds & Uygun, 2018). According to OECD's determinations, innovation, which has contributed more than 50% to the economic growth of especially developed countries in the last 25 years (Ayçin & Çakın, 2019: 327; Işik & Kilinç, 2012), has become a very interesting topic for both academics and decision makers (Schroeder, Scudder, & Elm, 1989) for innovative companies that are indispensable for a dynamic and competitive economy (Madrid-Guijarro et al., 2009: 465).

From this point of view, in this study which aims to analyze the innovation capabilities of the manufacturing sectors in Turkey and selected OECD countries including Turkey on a national basis, the criteria to be used in the comparison were determined by first searching the literature. Eighteen of the innovation indicators used by the OECD were used as criteria in this study. CRITIC method and EDAS method, which are among the multi-criteria decision making (MCDM) methods, were used in this study since the use of scientific methods in decision-making processes allows the results to be far from subjective and have higher reliability (Çatı, Eş, & Özevin, 2017: 202). The CRITIC method was used to determine the criterion weights. Using the EDAS method, the innovation capabilities of the manufacturing sectors of the countries were ranked on a national basis.

I. LITERATURE REVIEW

Since there are many criteria and alternatives in benchmarking and comparison problems, it may be insufficient to offer a realistic solution with traditional selection procedures (Çatı et al., 2017, 202). It is considered necessary to solve complex decision problems with quantitative decision analysis methods. For this reason, operations research-based multi-criteria decision making (MCDM) methods are frequently used recently (Arslan, Köse, & Durak, 2018; Çatı et al., 2017: 202). Multi-criteria decision-making methods are approaches that include evaluating two or more alternatives with two or more criteria, ranking them and choosing among the alternatives (Çatı et al., 2017; Pohekar & Ramachandran, 2004). MCDM has gained serious acceptance in recent years. Especially as new methods are developed and old methods are improved, its role in different application areas has increased significantly (Velasquez & Hester, 2013). A wide range of MCDM methods can be used, such as comparing individuals, companies, sectors (Apan & Öztel, 2020; Eş & Çobanoğlu, 2017; Orhan, Altun, & Aytekin, 2020; Şenkal & Öztel, 2020), comparing countries (Orhan, 2019; Orhan & Aytekin, 2020); personnel selection (Dahooie, Abadi, Vanaki, & Firoozfar, 2018; Krishankumar et al., 2020; Nabeeh, Smarandache, Abdel-Basset, El-Ghareeb, & Aboelfetouh, 2019) outsourcing provider selection (Lin, Lin, Yu, & Tzeng, 2010), and supplier selection (Hamdan & Cheaitou, 2017; Liu, Quan, Li, & Wang, 2019; Önüt, Kara, & Işik, 2009: 3887; Stević, Pamučar, Puška, & Chatterjee, 2020; Yazdani, Chatterjee, Zavadskas, & Hashemkhani Zolfani, 2017).

At this stage of the study, the studies carried out in the manufacturing sector using MCDM methods are given respectively. Singh et al., (2021) analyzed the performance indicators of advanced manufacturing technology applications using AHP and TOPSIS methods (Singh, Deep Singh, & Deepak, 2021). Using AHP, VIKOR and TOPSIS methods, the 10 largest steel companies operating in the manufacturing sector in Egypt were evaluated according to certain financial ratios (Abdel-Basset, Ding, Mohamed, & Metawa, 2020). Korkmaz and Öztel (2020) analyzed the financial performances of 17 heavy metal industry companies traded on Borsa Istanbul (BIST) in the 2014-2018 period using the multi-criteria decision-making (MCDM) methods, PROMETHEE, and Entropy. Some financial ratios calculated by using income and balance sheet tables from financial performance indicators are used in the analysis. While the importance degrees (weights) of the criteria were determined by the entropy method, the financial performance rankings of the companies were determined by the PROMETHEE method (Korkmaz & Öztel, 2020). Korucuk (2019) revealed the importance of SWARA-based ARAS and COPRAS methods and Supply Chain Management (SCM) performance factors in manufacturing enterprises with 50 or more employees in Ordu province and chose the most ideal competitive strategy. As a result of the evaluation, the most important of the SCM performance elements was the "flexibility" factor. On the other hand, it has been concluded that the "Focusing strategy" is the most ideal competitive strategy in both ARAS and COPRAS methods (Korucuk, 2019). A performance ranking was made by Gök-Kısa and Perçin (2018) for companies operating in Fuzzy Analytical Hierarchy Process (FAHP), Fuzzy TOPSIS, Fuzzy VIKOR Turkish Manufacturing Industry in 8 different sectors registered in Borsa Istanbul. Three different performance rankings have been reached for the companies in question from the application of all three methods. To integrate these rankings, the Borda Count (BC) method was used and the final rankings were obtained. Thus, both the results of different MCDM methods can be seen and evaluated holistically. Medić et al. (2018) Organizational innovation types used in manufacturing companies in developing countries were compared using the Fuzzy Analytical Hierarchy Process (FAHP) and PROMETHEE methods. Fuzzy Analytical Hierarchy Process (FAHP) and Ordering of Preferences by Proximity to Fuzzy Ideal Solutions (BTOPSIS) methods were used by Kul, Şeker, and Yurdakul (2014) for the selection of nontraditional manufacturing methods (NMM). In the study, the effects of turbidity on the results were determined by comparing the results obtained with fuzzy methods with the classical AHP and TOPSIS methods. As a result of the analysis, it has been revealed that weighting is more effective in the ranking result and Fuzzy AHP stage is much more important than Fuzzy TOPSIS. By using the fuzzy MCDM / MCDM approach by Chan and Prakash (2012), alternatives for maintenance policy in manufacturing companies were determined, ranked and maintenance policy selection was made. Tzeng and Huang (2012) conducted a study aiming to solve the problem of global production and logistics strategy selection and system restructuring by using ANP, GRA, and VIKOR methods. When the studies in the literature are evaluated, many studies have been carried out using MCDM in the manufacturing sector. However, no study has been found to compare the innovation capabilities of manufacturing sectors in OECD member countries, including Turkey, with MCDM methods on a national basis.

II. MATERIAL AND METHOD

When the studies in the literature are examined, no study has been found to compare the innovation capabilities of manufacturing sectors in OECD member countries, including Turkey, with MCDM methods on a national basis. In this study, it is aimed to analyze the innovation capabilities of manufacturing sectors in selected OECD countries by using innovation indicators and to compare them on a national basis. The criteria and criteria codes that are widely used as benchmark variables in the analysis and comparison of the innovation performance of the manufacturing sectors of OECD countries with the literature review are given in Table 1.

Table 1. Criterias Used in Analysis

Criteria Code	Criterias
K1	Innovative firms [1,2]
K2	Product and/or process innovative firms[2,3]
K3	Product and/or process innovation-active firms [2,4]
K4	Product innovative firms[2,5]
K5	Process innovative firms[2,5]
K6	Organisation innovative firms[2,5]
K7	Marketing innovative firms[2,5]
K8	Product and/or process innovation-active firms only [2,6]
K9	Organisation and/or marketing innovative firms only[2]
K10	Product and/or process and marketing and/or organisational innovations only [2,7]
K11	Product innovative firms with innovations that were new to the firm's market [2]
K12	R&D active product and/or process innovative firms [4,8]
K13	Firms co-operating on innovation activities[4,8]
K14	Firms co-operating on innovation activities with suppliers[4,8]
K15	Firms co-operating on innovation activities with clients (private and/or public sector) [4,8]
K16	Firms co-operating on innovation activities with higher education or government institutions[4,8]
K17	Firms engaged in national collaboration only[4,9]
K18	Firms engaged in international collaboration[4,8]

Resource: OECD Business innovation statistics and indicators (www.oecd.org/innovation/inno-stats.htm) ('Business Innovation Statistics and Indicators - OECD', 2020)

1. Product/process or organisational/marketing, 2. As a percentage of total firms, 3. Regardless of organisational or marketing innovation, 4.product/process or ongoing/abandoned innovation activities, regardless of organisational or marketing innovation, 5. Regardless of any other type of innovation, 6. Product/process or ongoing/abandoned innovation activities, 7. İncluding enterprises with ongoing/abandoned innovation activities, 8. As a percentage of product and/or process innovation-active firms**,** 9. Product/process or ongoing/abandoned innovation activities,

The year 2019 was taken as a basis in the analyzes related to the comparison of the innovation capabilities of the manufacturing sectors in different countries. The data of the countries' innovation indicators for 2019 were obtained from databases of Organization for Economic Cooperation and Development (OECD). The data of the countries regarding the criteria are presented in Table 2. The CRITIC method was used to determine the criterion weights; because the CRITIC method allows the determination of criterion weights objectively, away from subjective evaluations. The EDAS method was used to rank the manufacturing sectors of different countries according to their innovation capabilities on a national basis.

Since some data of innovation indicators of Colombia, Israel, Mexico, Czechia, Ireland, Luxembourg, and Slovenia could not be reached, these countries were excluded from the evaluation. The comparison was made according to the innovation capacities of the manufacturing sectors of 30 OECD member countries (Australia, Austria, Belgium, Canada, Switzerland, Chile, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Hungary, Ireland, Iceland, Italy, Japan, Republic of Korea, Lithuania, Latvia, Netherlands, Norway, New Zealand, Poland, Portugal, Slovakia, Slovenia, Sweden, and the United States), whose data on innovation indicators used in the analyzes could be accessed.

Table 2. Countris' Data on Innovation Criterias

Countris	Code	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18
Australia	AUS	56	47	51	30	35	27	20	22	9	29	10	26	22	10	8	2	13	10
Austria	AUT	64	54	55	39	43	39	35	13	10	42	26	56	52	33	27	28	16	36
Belgium	BEL	66	61	69	41	44	42	30	24	5	45	33	61	39	30	14	19	14	8
Canada	CAN	86	76	76	57	66	61	50	13	10	63	29	57	26	16	12	8	12	14
Switzerland	CHE	75	56	57	42	32	40	49	14	18	42	16	61	24	18	14	14	6	17
Chile	CHL	27	25	25	14	17	15	13	10	2	15	4	35	23	16	7	13	23	12
Germany	DEU	66	54	58	40	32	37	32	22	12	37	16	53	24	11	11	16	13	10
Denmark	DNK	48	38	39	26	25	31	28	9	10	30	15	54	44	34	26	23	15	29
Spain	ESP	37	26	28	15	18	23	16	12	11	16	7	53	31	16	10	13	17	12
Estonia	EST	52	50	51	23	40	18	13	31	3	20	12	36	54	50	23	15	16	38
Finland	FIN	69	64	66	47	48	41	33	22	5	44	28	79	43	33	32	31	12	31
France	FRA	58	46	48	31	35	39	27	14	12	34	22	69	34	24	22	17	15	18
United Kingdom	GBR	56	44	47	32	24	34	12	23	13	24	13	69	66	55	58	28	57	36
Greece	GRC	59	47	48	34	40	29	43	11	11	38	24	53	43	36	29	20	20	23
Hungary	HUN	27	20	22	15	11	11	12	11	7	12	7	37	28	20	15	11	0	18
Iceland	ISL	47	44	47	32	31	23	21	18	3	29	21	47	56	38	34	20	28	28
Italy	ITA	56	48	50	35	37	28	26	18	7	32	21	51	13	7	3	5	8	5
Japan	JPN	40	39	44	19	32	13	7	28	1	15	10	26	33	16	17	19	27	6
Republic of Korea	KOR	45	31	38	21	15	31	25	14	13	23	5	54	22	13	14	8	18	3
Lithuania	LTU	51	41	42	30	34	21	27	17	10	25	18	34	40	36	16	13	14	26
Latvia	LVA	33	25	26	17	17	18	15	10	8	16	13	46	26	18	12	10	7	18
Netherlands	NLD	63	57	59	41	36	26	19	31	6	28	31	77	34	25	11	13	13	16
Norway	NOR	67	60	62	45	40	35	37	20	7	42	24	65	43	23	18	15	21	18
New Zeland	NZL	48	43	49	27	25	25	22	20	5	29	16	36	27	18	16	9	15	13
Poland	POL	23	19	20	13	15	10	10	11	5	9	7	40	33	20	12	21	18	15
Portugal	PRT	63	57	58	39	48	29	33	20	6	37	19	38	17	10	9	9	8	9
Slovakia	SVK	32	25	27	16	17	14	15	12	7	15	10	45	37	27	19	12	5	31
Sweden	SWE	53	45	47	30	28	19	26	22	9	25	19	68	34	28	25	20	33	24
Turkey	TUR	63	51	53	36	40	34	47	11	13	42	26	33	20	6	6	4	4	4
United States of America	USA	67	53	57	34	42	43	36	17	13	38	20	60	74	58	54	15	72	15

II.I. CRITIC Method

In applications with MCDM methods, objective or subjective weighting methods are used to weight the criteria (Rani et al., 2021). While the importance levels (weights) of the criteria are determined according to the decision makers with the subjective weighting methods, in the weighting made with the objective weighting methods, the weights of the criteria are determined objectively, away from subjective judgments, by applying some mathematical models on the decision matrix (Kiracı & Bakır, 2019: 160). The CRITIC method was developed in order to determine the importance levels (weights) of the criteria using direct objective data without the need for any decision maker opinion (Şenol & Ulutaş, 2018: 93).

The CRITIC method consists of the following steps (Diakoulaki, Mavrotas, & Papayannakis, 1995, pp. 764–765; Kiracı & Bakır, 2019, pp. 160–161; Krishnan, Kasim, Hamid, & Ghazali, 2021; Perçin & Çakır, 2013: 451; Žižović, Miljković, & Marinković, 2020, pp. 151–153).

<u>*Step 1 Creating the Decision Matrix:*</u> In the first step of the CRITIC method, as in other MCDM methods, the decision matrix containing the criteria and alternatives for the decision problem is created (Equation 1).

$$A_{ij} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} \quad (1)$$

As seen in Equation 1, there are n criteria and m alternatives in the decision matrix.

Step 2 Generating the Normalized Decision Matrix: In the second step of the application, the normalization process is performed with the help of equation (2) in order to convert the criteria values to the common unit (eliminating the anomalies).

$$r_{ij} = \frac{x_{ij} - x_{ij}^{min}}{x_{ij}^{max} - x_{ij}^{min}} \quad (2)$$

$x_{ij}^{max} =$ the highest value of the j criterion , $x_{ij}^{min} =$ the lowest value of the j criterion

While r_{ij} represents the normalized version of each value, the benefit/cost situation of the criteria is not taken into account in the normalization process (Adali & Işik, 2017) .

Step 3 Calculation of Bilateral Correlations between Criteria: In this step, the correlation coefficients between the pairs of criteria are calculated with the help of equation (3) in order to determine the strength of the relationship between the criteria.

$$\rho_{jk} = \frac{\sum_{i=1}^{m}(r_{ij} - \bar{r}_j)(r_{ik} - \bar{r}_k)}{\sqrt{\sum_{i=1}^{m}(r_{ij} - \bar{r}_j)^2 \sum_{i=1}^{m}(r_{ik} - \bar{r}_k)^2}} \quad (3)$$

As seen in Equation (3), while Pearson correlation coefficient is used, Spearman rank correlation coefficients, which are the non-parametric equivalent of the test, are used in cases where the number of alternatives is relatively low (Perçin & Çakır, 2013).

Step 4 Calculation of the Amount of Information (c_j): In this step, the total amount of information contained in each criterion (c_j) is calculated with the help of equation (4). While performing this operation, the standard deviation of the normalized decision matrix column values (σ_j) is used.

$$c_j = \sigma_j \sum_{k=1}^{n}(1 - \rho_{jk}) \quad (4)$$

Step 5 Obtaining Criterion Weights: In this step, which constitutes the last step of the CRITIC method, the criteria weights (w_j) that express the weight coefficient of the j criterion are calculated. In the weighting process performed with the help of equation (5), the criterion with the highest value is accepted as the criterion with the highest level of importance (most important).

$$w_j = \frac{c_j}{\sum_{k=1}^{n} c_k} \quad (5)$$

II.II. EDAS Method

The EDAS method is one of the MCDM methods and was developed by Ghorabaee, Zavadskas, Olfat and Turskis. The EDAS method uses evaluations based on the mean solution distance to determine the most optimal among the alternatives in the decision-making stages (Akbulut, 2019: 254) (Akbulut, 2019: 254). The application steps of the EDAS method are as follows (Akbulut, 2019, pp. 254–257; Zavadskas, Stević, Turskis, & Tomašević, 2019, pp. 257–258):

Step 1. It is the creation of a decision matrix. In the first step of the EDAS method, a decision matrix with n criteria and m alternatives is created in nxm dimensions as in other MCDM methods.

$$X = [X_{ij}]_{nxm} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ \vdots & \vdots & \cdots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \quad (6)$$

Step 2. It is the creation of the mean values matrix (AV_j). In the second step of the EDAS method, mean solution matrices are created using Equation (8) for the evaluation criteria.

$$AV = [AV_j]_{1xm} \quad (7)$$

$$AV_j = \frac{\sum_{i=1}^{n} X_{ij}}{n} \quad (8)$$

Step 3. It is the creation of positive and negative distance matrices from the mean. At this stage, a positive distance matrix from the mean (PDA) and a negative distance from the mean matrix (NDA) are created regarding the criteria. Before calculating these values, it is necessary to pay attention to the benefit or cost characteristics of the criteria; because calculations differ according to benefit or cost characteristics.

$$\text{PDA} = [\text{PDA}_{ij}]_{nxm} \quad (9)$$

$$\text{NDA} = [\text{NDA}_{ij}]_{nxm} \quad (10)$$

In the above equations (9) (10), PDA represents the positive distance of the alternative i from the mean solution in terms of the j criterion. NDA represents the negative distance of the alternative i from the mean solution in terms of j criteria. It is calculated using Equations (11) and (12) for benefit-oriented criteria.

$$\text{PDA}_{ij} = \frac{\max(0,(X_{ij} - AV_j))}{AV_j} \quad (11)$$

$$\text{NDA}_{ij} = \frac{\max(0,(AV_j - X_{ij}))}{AV_j} \quad (12)$$

For cost-oriented criteria, positive and negative distance values from the mean are calculated using Equations (13) and (14).

$$\text{PDA}_{ij} = \frac{\max(0,(AV_j - X_{ij}))}{AV_j} \quad (13)$$

$$\text{NDA}_{ij} = \sum_{i=1}^{n} X_{ij} \frac{\max\left(0,\left(X_{ij} - AV_j\right)\right)}{AV_j} \quad (14)$$

Step 4. It is the calculation of weighted total values. At this stage, weighted total positive distances (SP_i) and weighted total negative (SN_i) distances are calculated with the help of Equations (15) and (16). The w_j in the equations represents the importance weight of each evaluation criterion.

$$\mathrm{SP}_i = \sum_{i=1}^{n} w_j \, \mathrm{PDA}_{ij} \tag{15}$$

$$\mathrm{SN}_i = \sum_{i=1}^{n} w_j \, \mathrm{NDA}_{ij} \tag{16}$$

Step 5. It is the normalization of weighted total distances. Weighted and normalized NSP_i and NSN_i values for all alternatives are calculated using Equations (17) and (18).

$$\mathrm{NSP}_i = \frac{\mathrm{SP}_i}{mak(\mathrm{SP}_i)} \tag{17}$$

$$\mathrm{NSN}_i = 1 - \frac{SN_i}{mak(SN_i)} \tag{18}$$

Step 6. It is the calculation of success scores for each alternative. In the last stage of the method, the NSP_i and NSN_i values calculated in the previous stage are averaged, and the success scores to be used in the performance evaluation for each alternative are obtained using AS_i Equation (19). The alternative with the highest AS_i value is considered the best alternative.

$$\mathrm{AS}_i = \frac{1}{2}(\mathrm{NSN}_i + \mathrm{NSP}_i) \tag{19}$$

Evaluation scores calculated for each decision alternative will take values between 0 and 1. As a result of the calculations, the decision alternative with the highest score will be determined as the best alternative.

III. RESULTS

In order to analyze the innovation capabilities of the manufacturing sectors in selected OECD countries (Australia, Austria, Belgium, Canada, Switzerland, Chile, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Hungary, Ireland, Iceland, Italy, Japan, Republic of Korea, Lithuania, Latvia, Netherlands, Norway, New Zealand, Poland, Portugal, Slovakia, Slovenia, Sweden, and the United States), including Turkey, the importance levels of the criteria were determined by the CRITIC method in order to compare them on a national basis by using innovation indicators. Then, the findings obtained as a result of the analyzes made to compare the manufacturing sectors on a national basis using the EDAS method were revealed.

III.I. Results of the CRITIC Method

In Step 1, the decision matrix, which forms the basis for the analyzes made with the CRITIC method, was created. As presented in Table 3, the decision matrix is a 30x18 type matrix consisting of 30 alternatives and 18 criteria.

Table 3. Decision matrix of the CRITIC Method

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18
AUS	55,9	47,2	51,0	29,7	35,1	26,8	19,7	22,1	8,7	28,9	9,6	26,1	22,1	10,3	7,8	1,6	12,6	9,5
AUT	64,1	54,3	54,8	39,4	43,2	39,4	34,7	13,2	9,7	41,6	26,1	55,8	51,9	33,2	26,9	28,5	15,8	36,1
BEL	65,9	60,5	69,0	41,0	44,0	41,6	29,7	23,7	5,4	45,3	33,1	60,6	38,7	29,6	13,8	18,6	13,6	8,1
CAN	85,5	75,9	75,9	57,5	66,2	60,9	50,3	13,1	9,6	62,9	28,7	57,3	26,4	15,7	12,5	8,0	12,1	14,2
CHE	74,6	56,3	56,5	41,6	31,5	39,8	49,5	14,1	18,3	42,4	16,1	61,5	23,7	17,7	14,4	14,1	5,7	17,4
CHL	26,8	24,6	25,4	13,8	17,1	15,3	12,5	10,0	2,1	15,3	3,8	34,7	22,9	15,6	7,0	13,2	22,7	12,4
DEU	65,9	54,3	58,5	39,7	31,7	37,4	31,9	21,6	11,6	36,9	16,0	52,9	23,6	10,6	11,2	16,0	13,3	10,3
DNK	48,2	37,9	39,1	26,3	25,3	30,6	27,6	9,3	10,3	29,6	14,6	54,1	44,0	34,0	25,9	22,7	14,6	28,7
ESP	36,6	25,5	28,1	14,8	18,5	22,6	15,6	11,6	11,0	16,4	7,2	52,6	31,2	15,7	9,8	13,2	16,9	11,5
EST	52,2	49,6	51,4	23,1	39,8	18,0	13,2	31,2	2,6	20,3	12,3	36,0	54,0	50,5	22,9	14,9	16,3	37,8
FIN	69,0	63,9	66,1	46,7	48,3	40,9	32,7	21,9	5,0	44,3	28,1	79,0	43,2	33,3	31,5	31,2	12,1	31,1
FRA	58,0	46,1	48,4	30,6	34,6	38,6	26,6	14,2	11,8	34,1	22,1	68,7	33,9	24,1	21,9	16,7	14,7	17,5
GBR	56,4	43,6	47,4	32,1	24,1	34,2	12,2	22,9	12,8	24,5	13,4	68,6	66,4	54,5	57,8	28,1	57,2	35,9
GRC	58,6	47,2	48,2	33,6	39,7	29,4	42,7	10,5	11,4	37,7	23,9	52,9	42,7	36,4	28,5	20,1	20,1	22,6
HUN	27,1	20,4	22,4	15,2	11,3	11,4	12,5	10,8	6,7	11,7	7,2	36,5	27,6	20,0	15,0	10,9	0,0	18,1
ISL	47,0	44,2	46,7	31,6	30,8	23,1	20,9	17,9	2,7	28,8	20,9	47,1	56,5	38,2	33,5	20,0	28,2	28,2
ITA	55,8	48,4	50,4	35,3	36,8	28,3	26,1	17,9	7,4	32,5	20,7	51,1	13,0	6,8	3,1	5,5	8,1	4,9
JPN	40,4	39,3	43,5	19,3	32,4	13,1	6,9	27,8	1,1	14,6	9,9	26,2	33,3	16,2	16,9	18,9	27,3	5,8
KOR	44,6	31,3	37,7	21,4	14,7	31,0	25,5	14,5	13,3	23,2	5,5	54,5	21,6	13,1	13,7	8,0	18,4	2,9
LTU	51,0	41,3	41,9	29,9	33,9	20,9	27,5	16,9	9,7	25,0	18,0	34,0	39,6	35,5	16,5	13,2	14,1	25,5
LVA	32,8	24,9	25,9	17,2	17,4	18,3	15,1	10,1	7,9	15,7	12,7	46,1	25,7	18,4	11,6	10,2	7,5	18,2
NLD	62,7	56,8	58,7	41,5	35,9	25,7	18,9	31,2	5,9	27,6	31,4	77,1	33,6	25,0	11,3	12,9	13,0	15,6
NOR	67,1	59,6	62,2	44,9	40,0	34,9	37,3	20,1	7,5	42,2	23,7	64,9	42,7	22,7	18,2	15,0	21,5	17,7
NZL	48,2	43,3	49,0	27,4	25,1	24,8	22,4	19,8	4,9	29,2	15,9	35,7	27,3	17,7	16,4	9,0	14,7	12,6
POL	23,5	18,9	20,2	12,9	15,0	9,6	9,5	10,7	4,6	9,5	6,6	39,9	32,8	19,7	11,8	21,0	17,8	15,1
PRT	63,0	56,8	57,8	39,3	47,9	28,7	32,7	20,5	6,3	37,3	19,3	38,3	17,1	10,4	8,6	8,8	7,8	9,3
SVK	31,8	25,3	27,0	15,7	17,0	14,3	14,7	11,9	6,6	15,1	9,6	44,9	36,5	26,7	19,2	12,4	5,2	31,3
SWE	53,4	44,6	47,5	30,3	28,4	19,3	26,0	22,4	8,8	25,1	18,7	67,6	34,0	27,6	24,5	19,7	32,5	23,5
TUR	63,2	50,7	52,8	35,5	39,6	33,8	47,1	11,3	12,5	41,5	26,3	32,7	19,7	6,3	6,0	4,3	4,2	3,6
USA	66,6	53,1	57,3	34,4	41,6	43,2	36,1	17,3	13,5	38,2	20,5	60,2	73,8	58,2	53,7	14,8	72,2	15,5
Min	23,5	18,9	20,2	12,9	11,3	9,6	6,9	9,3	1,1	9,5	3,8	26,1	13,0	6,3	3,1	1,6	0,0	2,9
Max	85,5	75,9	75,9	57,5	66,2	60,9	50,3	31,2	18,3	62,9	33,1	79,0	73,8	58,2	57,8	31,2	72,2	37,8

In Step 2, the normalized decision matrix is created. The normalized decision matrix is calculated with the help of equation (2). In this step, while calculating the amount of information ($\boldsymbol{c_j}$) of the normalization process, the required standard deviation values were also calculated. In step 3, the binary correlations between the criteria were calculated in this step. In order to determine the degree of relationship between the criteria, the correlation coefficients between the criteria were calculated with the help of equation (3). In step 4, the amount of information (c_j) was calculated in this step. The total amount of information (c_j) included in all criteria was calculated using equation (4). In step 5, In this step, criterion weights were calculated. The degree of importance (weighting coefficient) (w_j) of the criteria was calculated with the help of Equation (5). It is accepted that the criterion with the highest value among the criteria is the criterion with the highest weight (significance), that is, it is the most effective criterion in comparisons. The weights (w_j) values and ranking of evaluation criteria the calculated are presented in the lower part of Table 4.

According to the results of the analysis, it has been determined that the most important 5 criteria are as follows: " Firms with only product and/or process innovation active as a percentage of total firms (product/process or ongoing/abandoned innovation activities) (K8)", " Firms that collaborate internationally as a percentage of firms active in product and/or process innovation (product/process or ongoing/abandoned innovation activities regardless of organizational or marketing innovation) (K18)", "Only organizational and/or marketing innovative firms as a percentage of total firms (K9)", "Firms collaborating on innovation activities with suppliers as percentage of firms active in product and/or process innovation (product/process or ongoing/abandoned innovation activities regardless of organizational or marketing innovation) (K14)", and " Firms collaborating on innovation activities with higher education or government institutions as a percentage of firms active in product and/or process innovation (product/process or ongoing/abandoned innovation activities regardless of organizational or marketing innovation) (K16)". It was found that the criterion with the lowest importance was "Organizational innovative firms as a percentage of total firms (regardless of any other type of innovation) (K6)".

Table 4. Calculated Information Amount Values(c_j) ve Criterion Weights (w_j)

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18
K1	0,00	0,03	0,05	0,04	0,14	0,12	0,19	0,67	0,58	0,07	0,22	0,50	0,88	0,89	0,82	0,94	0,91	1,00
K2	0,03	0,00	0,01	0,04	0,07	0,19	0,28	0,55	0,82	0,09	0,18	0,56	0,87	0,89	0,87	0,92	0,94	0,98
K3	0,05	0,01	0,00	0,06	0,10	0,19	0,32	0,50	0,83	0,11	0,19	0,56	0,86	0,89	0,85	0,92	0,90	1,03
K4	0,04	0,04	0,06	0,00	0,14	0,15	0,22	0,70	0,72	0,06	0,16	0,47	0,92	0,95	0,88	0,90	0,99	0,99
K5	0,14	0,07	0,10	0,14	0,00	0,27	0,33	0,66	0,96	0,14	0,21	0,74	0,87	0,89	0,92	0,96	0,97	0,98
K6	0,12	0,19	0,19	0,15	0,27	0,00	0,21	0,99	0,48	0,07	0,33	0,45	0,86	0,91	0,77	0,91	0,86	1,05
K7	0,19	0,28	0,32	0,22	0,33	0,21	0,00	1,20	0,41	0,11	0,36	0,67	1,07	1,08	1,00	1,08	1,10	1,12
K8	0,67	0,55	0,50	0,70	0,66	0,99	1,20	0,00	1,35	0,94	0,73	0,85	0,79	0,77	0,87	0,90	0,78	0,95
K9	0,58	0,82	0,83	0,72	0,96	0,48	0,41	1,35	0,00	0,63	0,91	0,64	0,99	0,97	0,80	1,08	0,86	1,06
K10	0,07	0,09	0,11	0,06	0,14	0,07	0,11	0,94	0,63	0,00	0,20	0,57	0,96	1,00	0,91	0,97	1,02	1,06
K11	0,22	0,18	0,19	0,16	0,21	0,33	0,36	0,73	0,91	0,20	0,00	0,46	0,81	0,83	0,87	0,81	1,03	0,93
K12	0,50	0,56	0,56	0,47	0,74	0,45	0,67	0,85	0,64	0,57	0,46	0,00	0,67	0,67	0,58	0,50	0,74	0,73
K13	0,88	0,87	0,86	0,92	0,87	0,86	1,07	0,79	0,99	0,96	0,81	0,67	0,00	0,05	0,09	0,35	0,27	0,31
K14	0,89	0,89	0,89	0,95	0,89	0,91	1,08	0,77	0,97	1,00	0,83	0,67	0,05	0,00	0,12	0,39	0,33	0,26
K15	0,82	0,87	0,85	0,88	0,92	0,77	1,00	0,87	0,80	0,91	0,87	0,58	0,09	0,12	0,00	0,36	0,20	0,38
K16	0,94	0,92	0,92	0,90	0,96	0,91	1,08	0,90	1,08	0,97	0,81	0,50	0,35	0,39	0,36	0,00	0,63	0,34
K17	0,91	0,94	0,90	0,99	0,97	0,86	1,10	0,78	0,86	1,02	1,03	0,74	0,27	0,33	0,20	0,63	0,00	0,80
K18	1,00	0,98	1,03	0,99	0,98	1,05	1,12	0,95	1,06	1,06	0,93	0,73	0,31	0,26	0,38	0,34	0,80	0,00
	K1	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**	**K9**	**K10**	**K11**	**K12**	**K13**	**K14**	**K15**	**K16**	**K17**	**K18**
c_j	1,97	2,03	2,13	2,10	2,09	1,97	2,97	4,06	3,24	2,05	2,54	2,84	2,75	3,09	2,60	3,07	2,72	4,01
w_j	0,04	0,04	0,04	0,04	0,04	0,04	0,06	0,08	0,07	0,04	0,05	0,06	0,06	0,06	0,05	0,06	0,06	0,08
Series	17	15	12	13	14	18	6	1	3	16	11	7	8	4	10	5	9	2

III.II. Results of the EDAS Method

The findings obtained in the analysis made in order to compare the innovation capabilities of the manufacturing sectors in selected OECD countries (Australia, Austria, Belgium, Canada, Switzerland, Chile, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Hungary, Ireland, Iceland, Italy, Japan, Republic of Korea, Lithuania, Latvia, Netherlands, Norway, New Zealand, Poland, Portugal, Slovakia, Slovenia, Sweden, Turkey and the United States), including Turkey, by using the EDAS method on a national basis, are presented in stages. In step 1, the decision matrix was created. The decision matrix, consisting of 18 criteria and 30 alternatives, was created in 30x18 dimensions.

The combined decision matrix including all alternatives and criteria as well as the weight of each criterion ($\boldsymbol{w_j}$) is presented in Table 5. In step 2: At this step, the mean values matrix (AV_j) was created. In the EDAS method, the average values matrix of the criteria was determined with the help of Equation (8). The calculated mean solution matrix (AV_j) values are shown in the decision matrix in Table 4.

Table 5. EDAS Method Unified Decision Matrix

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18
w_j	0,041	0,042	0,044	0,044	0,043	0,041	0,061	0,084	0,067	0,042	0,053	0,059	0,057	0,064	0,054	0,064	0,056	0,083
AUS	55,9	47,2	51,0	29,7	35,1	26,8	19,7	22,1	8,7	28,9	9,6	26,1	22,1	10,3	7,8	1,6	12,6	9,5
AUT	64,1	54,3	54,8	39,4	43,2	39,4	34,7	13,2	9,7	41,6	26,1	55,8	51,9	33,2	26,9	28,5	15,8	36,1
BEL	65,9	60,5	69,0	41,0	44,0	41,6	29,7	23,7	5,4	45,3	33,1	60,6	38,7	29,6	13,8	18,6	13,6	8,1
CAN	85,5	75,9	75,9	57,5	66,2	60,9	50,3	13,1	9,6	62,9	28,7	57,3	26,4	15,7	12,5	8,0	12,1	14,2
CHE	74,6	56,3	56,5	41,6	31,5	39,8	49,5	14,1	18,3	42,4	16,1	61,5	23,7	17,7	14,4	14,1	5,7	17,4
CHL	26,8	24,6	25,4	13,8	17,1	15,3	12,5	10,0	2,1	15,3	3,8	34,7	22,9	15,6	7,0	13,2	22,7	12,4
DEU	65,9	54,3	58,5	39,7	31,7	37,4	31,9	21,6	11,6	36,9	16,0	52,9	23,6	10,6	11,2	16,0	13,3	10,3
DNK	48,2	37,9	39,1	26,3	25,3	30,6	27,6	9,3	10,3	29,6	14,6	54,1	44,0	34,0	25,9	22,7	14,6	28,7
ESP	36,6	25,5	28,1	14,8	18,5	22,6	15,6	11,6	11,0	16,4	7,2	52,6	31,2	15,7	9,8	13,2	16,9	11,5
EST	52,2	49,6	51,4	23,1	39,8	18,0	13,2	31,2	2,6	20,3	12,3	36,0	54,0	50,5	22,9	14,9	16,3	37,8
FIN	69,0	63,9	66,1	46,7	48,3	40,9	32,7	21,9	5,0	44,3	28,1	79,0	43,2	33,3	31,5	31,2	12,1	31,1
FRA	58,0	46,1	48,4	30,6	34,6	38,6	26,6	14,2	11,8	34,1	22,1	68,7	33,9	24,1	21,9	16,7	14,7	17,5
GBR	56,4	43,6	47,4	32,1	24,1	34,2	12,2	22,9	12,8	24,5	13,4	68,6	66,4	54,5	57,8	28,1	57,2	35,9
GRC	58,6	47,2	48,2	33,6	39,7	29,4	42,7	10,5	11,4	37,7	23,9	52,9	42,7	36,4	28,5	20,1	20,1	22,6
HUN	27,1	20,4	22,4	15,2	11,3	11,4	12,5	10,8	6,7	11,7	7,2	36,5	27,6	20,0	15,0	10,9	0,0	18,1
ISL	47,0	44,2	46,7	31,6	30,8	23,1	20,9	17,9	2,7	28,8	20,9	47,1	56,5	38,2	33,5	20,0	28,2	28,2
ITA	55,8	48,4	50,4	35,3	36,8	28,3	26,1	17,9	7,4	32,5	20,7	51,1	13,0	6,8	3,1	5,5	8,1	4,9
JPN	40,4	39,3	43,5	19,3	32,4	13,1	6,9	27,8	1,1	14,6	9,9	26,2	33,3	16,2	16,9	18,9	27,3	5,8
KOR	44,6	31,3	37,7	21,4	14,7	31,0	25,5	14,5	13,3	23,2	5,5	54,5	21,6	13,1	13,7	8,0	18,4	2,9
LTU	51,0	41,3	41,9	29,9	33,9	20,9	27,5	16,9	9,7	25,0	18,0	34,0	39,6	35,5	16,5	13,2	14,1	25,5
LVA	32,8	24,9	25,9	17,2	17,4	18,3	15,1	10,1	7,9	15,7	12,7	46,1	25,7	18,4	11,6	10,2	7,5	18,2
NLD	62,7	56,8	58,7	41,5	35,9	25,7	18,9	31,2	5,9	27,6	31,4	77,1	33,6	25,0	11,3	12,9	13,0	15,6
NOR	67,1	59,6	62,2	44,9	40,0	34,9	37,3	20,1	7,5	42,2	23,7	64,9	42,7	22,7	18,2	15,0	21,5	17,7
NZL	48,2	43,3	49,0	27,4	25,1	24,8	22,4	19,8	4,9	29,2	15,9	35,7	27,3	17,7	16,4	9,0	14,7	12,6
POL	23,5	18,9	20,2	12,9	15,0	9,6	9,5	10,7	4,6	9,5	6,6	39,9	32,8	19,7	11,8	21,0	17,8	15,1
PRT	63,0	56,8	57,8	39,3	47,9	28,7	32,7	20,5	6,3	37,3	19,3	38,3	17,1	10,4	8,6	8,8	7,8	9,3
SVK	31,8	25,3	27,0	15,7	17,0	14,3	14,7	11,9	6,6	15,1	9,6	44,9	36,5	26,7	19,2	12,4	5,2	31,3
SWE	53,4	44,6	47,5	30,3	28,4	19,3	26,0	22,4	8,8	25,1	18,7	67,6	34,0	27,6	24,5	19,7	32,5	23,5
TUR	63,2	50,7	52,8	35,5	39,6	33,8	47,1	11,3	12,5	41,5	26,3	32,7	19,7	6,3	6,0	4,3	4,2	3,6
USA	66,6	53,1	57,3	34,4	41,6	43,2	36,1	17,3	13,5	38,2	20,5	60,2	73,8	58,2	53,7	14,8	72,2	15,5
A_j	53,2	44,9	47,4	30,7	32,2	28,5	25,9	17,3	8,3	29,9	17,4	50,6	35,3	24,8	19,1	15,1	18,0	18,0

In Step 3, positive and negative distance matrices from the mean were created. While constructing the negative distance from the mean (NDA) and the positive distance from the mean (PDA) matrix, different equations are used depending on whether the criteria show benefit or not. All of the criteria used in the analyzes show benefit. Therefore, Equation (11) was used while calculating the positive distance matrix (PDA) from the mean. All of the criteria used in the analyzes show benefits. Therefore, while calculating the negative distance matrix (NDA) from the mean. In Step 4, weighted total values were calculated in this step. In the first part of the analysis part of the study, the matrix of positive distances from the mean was calculated by multiplying the criteria weights calculated by the CRITIC method. Weighted total positive distances (SP_i) were calculated with the help of Equation (15). In the first part of the analysis part of the study, each value was multiplied by the criteria weights calculated by the CRITIC method. With the mean, the matrix of Positive distances is calculated. Weighted total negative distances (SN_i) distances were calculated with the help of Equation (16). Normalization (NSP_i) was performed with the help of Equation (17) to the weighted sums of the positive distances (SP_i) from the previously calculated mean. Obtained NSP_i values are shown in Table 6. Weighted sums of negative distances (SN_i) from the mean for each country in Table 6 are normalized with Equation (18) (NSN_i). Obtained NSN_i values are given in Table 6. Evaluation scores for each alternative country (AS_i) are calculated with the help of Equation (18). (AS_i) values and the order of these values are shown in Table 6. According to the results of the analysis made using the EDAS method in the relative ranking of the innovation capabilities of the manufacturing sectors in the selected OECD member countries on national basis, the relative ranking of the manufacturing sectors in the selected OECD member countries according to their innovation capabilities on national basis is as follows: United States, United Kingdom, Finland, Austria, Greece, Norway, Canada, Sweden, Iceland, Belgium, Switzerland, Estonia, France, Netherlands, Denmark, Lithuania, Germany, Portugal, New Zealand, Turkey, Slovakia, Italy, Australia, Japan, Republic of Korea, Spain, Latvia, Poland, Hungary, and Chile. The United States, the United Kingdom and Finland are in the first three places, while Poland, Hungary and Chile are in the last three places. Turkey ranks 20th. Turkey ranks higher than Slovakia, Italy, Australia, Japan, Republic of Korea, Spain, Latvia, Poland, Hungary, and Chile.

Table 6. Weighted Sums of Positive and Negative Distances from the Mean, Normalized Values of Weighted Sums, Country Evaluation Scores and Rankings

Code	Country	SPi	SNi	NSPi	NSNi	ASi	Rank
AUS	Australia	0,037	0,276	0,063	0,362	0,212	23
AUT	Austria	0,359	0,027	0,605	0,938	0,771	4
BEL	Belgium	0,248	0,098	0,418	0,774	0,596	10
CAN	Canada	0,367	0,143	0,619	0,669	0,644	7
CHE	Switzerland	0,234	0,116	0,395	0,731	0,563	11
CHL	Chile	0,015	0,433	0,025	0,000	0,012	30
DEU	Germany	0,132	0,133	0,223	0,692	0,458	17
DNK	Denmark	0,166	0,093	0,279	0,786	0,533	15
ESP	Spain	0,024	0,299	0,041	0,309	0,175	26
EST	Estonia	0,284	0,155	0,479	0,643	0,561	12
FIN	Finland	0,432	0,045	0,728	0,896	0,812	3
FRA	France	0,110	0,032	0,185	0,926	0,555	13
GBR	United Kingdom	0,593	0,064	1,000	0,851	0,926	2
GRC	Greece	0,238	0,033	0,401	0,923	0,662	5
HUN	Hungary	0,000	0,402	0,001	0,072	0,036	29
ISL	Iceland	0,224	0,078	0,378	0,819	0,598	9
ITA	Italy	0,038	0,267	0,064	0,382	0,223	22
JPN	Japan	0,096	0,321	0,163	0,257	0,210	24
KOR	Republic of Korea	0,050	0,293	0,084	0,323	0,203	25
LTU	Lithuania	0,088	0,078	0,149	0,821	0,485	16
LVA	Latvia	0,001	0,319	0,001	0,263	0,132	27
NLD	Netherlands	0,190	0,104	0,321	0,759	0,540	14
NOR	Norway	0,194	0,016	0,328	0,963	0,645	6
NZL	New Zeland	0,013	0,183	0,023	0,576	0,299	19
POL	Poland	0,025	0,376	0,043	0,131	0,087	28
PRT	Portugal	0,109	0,226	0,184	0,478	0,331	18
SVK	Slovakia	0,069	0,285	0,116	0,340	0,228	21
SWE	Sweden	0,166	0,028	0,279	0,935	0,607	8
TUR	Turkey	0,170	0,316	0,287	0,270	0,278	20
USA	United States of America	0,580	0,013	0,977	0,970	0,974	1

CONCLUSION

In this study, the innovation capabilities of the manufacturing sectors in selected OECD countries (Australia, Austria, Belgium, Canada, Switzerland, Chile, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Hungary, Ireland, Iceland, Italy, Japan, Republic of Korea, Lithuania, Latvia, Netherlands, Norway, New Zealand, Poland, Portugal, Slovakia, Slovenia, Sweden, Turkey, and the United States) including Turkey, were analyzed and compared on a national basis, using innovation indicators.

According to the results of the analysis performed for the objective calculation of the weights (significance levels) of the criteria used in the analyzes using the CRITIC method in this study, it has been determined that the 5 most important criteria are as follows: " Firms with only product and/or process innovation active as a percentage of total firms (product/process or ongoing/abandoned innovation activities) (K8)", "Product and/or process innovation, internationally collaborating firms as a percentage of active firms (product/process or ongoing/abandoned innovation activities regardless of organizational or marketing innovation) (K18)", " Only organizational and/or marketing innovative firms as a percentage of total firms (K9)", " Firms collaborating on innovation activities with suppliers as a percentage of firms active in product and/or process innovation (product/process or ongoing/abandoned innovation activities regardless of organizational or marketing innovation) (K14)", and " Firms collaborating on innovation activities with higher education or government institutions as a percentage of firms active in product and/or process innovation (product/process or ongoing/abandoned innovation activities regardless of organizational or marketing innovation) (K16)". The criterion with the lowest degree of importance was determined as "Organizational innovative firms as a percentage of total firms (independent of any other type of innovation)".

The relative ranking of the manufacturing sectors found in OECD member countries on a national basis according to their innovation capabilities is as follows according to the results of the analysis made using the EDAS method: United States, United Kingdom, Finland, Austria, Greece, Norway, Canada, Sweden, Iceland, Belgium, Switzerland, Estonia, France, Netherlands, Denmark, Lithuania, Germany, Portugal, New Zealand, Turkey, Slovakia, Italy, Australia, Japan, Republic of Korea, Spain, Latvia, Poland, Hungary, and Chile. The United States, the United Kingdom and Finland are in the top three places, while Poland, Hungary, and Chile are in the last three places. Turkey ranks 20th. Turkey ranks higher than Slovakia, Italy, Australia, Japan, Republic of Korea, Spain, Latvia, Poland, Hungary, and Chile. These results show that the innovation capacities of the manufacturing sectors in Turkey are relatively better than the aforementioned 10 countries.

According to the findings of the innovation capabilities of the manufacturing sector, Turkey ranks high among countries such as Italy, Australia, Japan, and Korea, which are well-known in the technology and manufacturing sector. With the help of support such as public facilities, university-industry cooperation projects, promotion of R&D in the manufacturing sector, which will be provided to companies that attach importance to innovation in the manufacturing sector in Turkey, the innovation capabilities of the manufacturing sector in Turkey can be increased and Turkey can be moved to higher ranks.

Eighteen of the innovation indicators published by the OECD, whose data can be accessed, were used in this study. Different results can be obtained when the study is carried out by using new indicators that can reach the data in future studies. The CRITIC method was used to determine the weights of the criteria. In the future, different results can be obtained in studies using the method(s) that provide subjective evaluation and/or different objective evaluation methods. The EDAS method was used in the relative ranking of the countries. Different results can be obtained in future studies using different multi-criteria decision making (MCDM) methods.

As a result, firms that do not adopt innovation, which is accepted as an important factor in the competitiveness of nations and firms, in their core business strategies face the risk of not being competitive due to outdated products and processes (Madrid-Guijarro et al., 2009: 465). For this reason, the sensitivity of both companies and countries to innovation will provide an advantage in making their own future more qualified.

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